NASA/SP—1998–7037/SUPPL377
June 26, 1998

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and
Space Administration
Langley Research Center
**Scientific and Technical
Information Program Office**

The NASA STI Program Office . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.
- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at ***http://www.sti.nasa.gov***
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Telephone the NASA STI Help Desk at (301) 621-0390
- Write to:
  NASA STI Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

Introduction

This supplemental issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA/SP—1998-7037) lists reports, articles, and other documents recently announced in the NASA STI Database.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section.

Two indexes—subject and author are included after the abstract section.

SCAN Goes Electronic!

If you have electronic mail or if you can access the Internet, you can view biweekly issues of *SCAN* from your desktop absolutely free!

Electronic SCAN takes advantage of computer technology to inform you of the latest worldwide, aerospace-related, scientific and technical information that has been published.

No more waiting while the paper copy is printed and mailed to you. You can view *Electronic SCAN* the same day it is released—up to 191 topics to browse at your leisure. When you locate a publication of interest, you can print the announcement. You can also go back to the *Electronic SCAN* home page and follow the ordering instructions to quickly receive the full document.

Start your access to *Electronic SCAN* today. Over 1,000 announcements of new reports, books, conference proceedings, journal articles...and more—available to your computer every two weeks.

Timely
Flexible
Complete
FREE!

For Internet access to *E-SCAN*, use any of the following addresses:

http://www.sti.nasa.gov
ftp.sti.nasa.gov
gopher.sti.nasa.gov

To receive a free subscription, send e-mail for complete information about the service first. Enter **scan@sti.nasa.gov** on the address line. Leave the subject and message areas blank and send. You will receive a reply in minutes.

Then simply determine the SCAN topics you wish to receive and send a second e-mail to **listserve@sti.nasa.gov**. Leave the subject line blank and enter a subscribe command in the message area formatted as follows:

Subscribe <desired list> <Your name>

For additional information, e-mail a message to **help@sti.nasa.gov**.

Phone: (301) 621-0390

Fax: (301) 621-0134

Write: NASA STI Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

Looking just for *Aerospace Medicine and Biology* reports?

Although hard copy distribution has been discontinued, you can still receive these vital announcements through your *E-SCAN* subscription. Just **subscribe SCAN-AEROMED** in the message area of your e-mail to **listserve@sti.nasa.gov**.

New Feature!
subscribe SCAN-AEROMED

Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR*, followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

Selecting an index above will link you to that comprehensive listing.

Document Availability

Select **Availability Info** for important information about NASA Scientific and Technical Information (STI) Program Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

Document Availability Information

The mission of the NASA Scientific and Technical (STI) Program Office is to quickly, efficiently, and cost-effectively provide the NASA community with desktop access to STI produced by NASA and the world's aerospace industry and academia. In addition, we will provide the aerospace industry, academia, and the taxpayer access to the intellectual scientific and technical output and achievements of NASA.

Eligibility and Registration for NASA STI Products and Services

The NASA STI Program offers a wide variety of products and services to achieve its mission. Your affiliation with NASA determines the level and type of services provided by the NASA STI Program. To assure that appropriate level of services are provided, NASA STI users are requested to register at the NASA Center for AeroSpace Information (CASI). Please contact NASA CASI in one of the following ways:

E-mail:	help@sti.nasa.gov
Fax:	301-621-0134
Phone:	301-621-0390
Mail:	ATTN: Registration Services NASA Center for AeroSpace Information 7121 Standard Drive Hanover, MD 21076-1320

Limited Reproducibility

In the database citations, a note of limited reproducibility appears if there are factors affecting the reproducibility of more than 20 percent of the document. These factors include faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, or some other factor that limits the reproducibility of the document. This notation also appears on the microfiche header.

NASA Patents and Patent Applications

Patents and patent applications owned by NASA are announced in the STI Database. Printed copies of patents (which are not microfiched) are available for purchase from the U.S. Patent and Trademark Office.

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the U.S. Patent and Trademark Office.

NASA patent application specifications are sold in both paper copy and microfiche by the NASA Center for AeroSpace Information (CASI). The document ID number should be used in ordering either paper copy or microfiche from CASI.

The patents and patent applications announced in the STI Database are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

National Aeronautics and Space Administration
Associate General Counsel for Intellectual Property
Code GP
Washington, DC 20546-0001

Sources for Documents

One or more sources from which a document announced in the STI Database is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below, with an Addresses of Organizations list near the back of this section. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source.

Avail: NASA CASI. Sold by the NASA Center for AeroSpace Information. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the citation. Current values are given in the NASA CASI Price Code Table near the end of this section.

Note on Ordering Documents: When ordering publications from NASA CASI, use the document ID number or other report number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy.

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in Energy Research Abstracts. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center—Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU International topic categories can be obtained from ESDU International.

Avail: Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, CA. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration (JBD-4), Public Documents Room (Room 1H23), Washington, DC 20546-0001, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: NTIS. Sold by the National Technical Information Service. Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) are available. For information concerning this service, consult the NTIS Subscription Section, Springfield, VA 22161.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from Dissertation Abstracts and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free.

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INlS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed on the Addresses of Organizations page. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Addresses of Organizations

British Library Lending Division
Boston Spa, Wetherby, Yorkshire
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

European Space Agency–
Information Retrieval Service ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International
27 Corsham Street
London
N1 6UA
England

Fachinformationszentrum Karlsruhe
Gesellschaft für wissenschaftlich–technische
Information mbH
76344 Eggenstein–Leopoldshafen, Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

(NASA STI Lead Center)
National Aeronautics and Space Administration
Scientific and Technical Information Program Office
Langley Research Center – MS157
Hampton, VA 23681

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, CA 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, MI 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library National Center
MS 950
12201 Sunrise Valley Drive
Reston, VA 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, AZ 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, CO 80225

NASA CASI Price Code Table

(Effective July 1, 1996)

CASI PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	$ 6.50	$ 13.00
A02	10.00	20.00
A03	19.50	39.00
A04-A05	21.50	43.00
A06	25.00	50.00
A07	28.00	56.00
A08	31.00	62.00
A09	35.00	70.00
A10	38.00	76.00
A11	41.00	82.00
A12	44.00	88.00
A13	47.00	94.00
A14-A17	49.00	98.00
A18-A21	57.00	114.00
A22-A25	67.00	134.00
A99	Call For Price	Call For Price

Important Notice

The $1.50 domestic and $9.00 foreign shipping and handling fee currently being charged will remain the same. Foreign airmail is $27.00 for the first 1-3 items, $9.00 for each additional item. Additionally, a new processing fee of $2.00 per each video ordered will be assessed.

For users registered at the NASA CASI, document orders may be invoiced at the end of the month, charged against a deposit account, or paid by check or credit card. NASA CASI accepts American Express, Diners' Club, MasterCard, and VISA credit cards. There are no shipping and handling charges. To register at the NASA CASI, please request a registration form through the NASA STI Help Desk at the numbers or addresses below.

Return Policy

The NASA Center for AeroSpace Information will gladly replace or make full refund on items you have requested if we have made an error in your order, if the item is defective, or if it was received in damaged condition and you contact us within 30 days of your original request. Just contact our NASA STI Help Desk at the numbers or addresses listed below.

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

E-mail: help@sti.nasa.gov
Fax: (301) 621-0134
Phone: (301) 621-0390

Rev. 3/98

Federal Depository Library Program

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 53 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 53 regional depositories. A list of the Federal Regional Depository Libraries, arranged alphabetically by state, appears at the very end of this section. These libraries are not sales outlets. A local library can contact a regional depository to help locate specific reports, or direct contact may be made by an individual.

Public Collection of NASA Documents

An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in the STI Database. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents FIZ–Fachinformation Karlsruhe–Bibliographic Service, D-76344 Eggenstein-Leopoldshafen, Germany and TIB–Technische Informationsbibliothek, P.O. Box 60 80, D-30080 Hannover, Germany.

Submitting Documents

All users of this abstract service are urged to forward reports to be considered for announcement in the STI Database. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to:

ATTN: Acquisitions Specialist
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320.

Reprints of journal articles, book chapters, and conference papers are also welcome.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on a public sale at the NASA Center for AeroSpace Information. Copyrighted publications will be announced but not distributed or sold.

Federal Regional Depository Libraries

ALABAMA
AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Dept.
7300 University Dr.
Montgomery, AL 36117–3596
(205) 244–3650 Fax: (205) 244–0678

UNIV. OF ALABAMA
Amelia Gayle Gorgas Library
Govt. Documents
P.O. Box 870266
Tuscaloosa, AL 35487–0266
(205) 348–6046 Fax: (205) 348–0760

ARIZONA
DEPT. OF LIBRARY, ARCHIVES, AND PUBLIC RECORDS
Research Division
Third Floor, State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 542–3701 Fax: (602) 542–4400

ARKANSAS
ARKANSAS STATE LIBRARY
State Library Service Section
Documents Service Section
One Capitol Mall
Little Rock, AR 72201–1014
(501) 682–2053 Fax: (501) 682–1529

CALIFORNIA
CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 942837 – 914 Capitol Mall
Sacramento, CA 94337–0091
(916) 654–0069 Fax: (916) 654–0241

COLORADO
UNIV. OF COLORADO – BOULDER
Libraries – Govt. Publications
Campus Box 184
Boulder, CO 80309–0184
(303) 492–8834 Fax: (303) 492–1881

DENVER PUBLIC LIBRARY
Govt. Publications Dept. BSG
1357 Broadway
Denver, CO 80203–2165
(303) 640–8846 Fax: (303) 640–8817

CONNECTICUT
CONNECTICUT STATE LIBRARY
231 Capitol Avenue
Hartford, CT 06106
(203) 566–4971 Fax: (203) 566–3322

FLORIDA
UNIV. OF FLORIDA LIBRARIES
Documents Dept.
240 Library West
Gainesville, FL 32611–2048
(904) 392–0366 Fax: (904) 392–7251

GEORGIA
UNIV. OF GEORGIA LIBRARIES
Govt. Documents Dept.
Jackson Street
Athens, GA 30602–1645
(706) 542–8949 Fax: (706) 542–4144

HAWAII
UNIV. OF HAWAII
Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948–8230 Fax: (808) 956–5968

IDAHO
UNIV. OF IDAHO LIBRARY
Documents Section
Rayburn Street
Moscow, ID 83844–2353
(208) 885–6344 Fax: (208) 885–6817

ILLINOIS
ILLINOIS STATE LIBRARY
Federal Documents Dept.
300 South Second Street
Springfield, IL 62701–1796
(217) 782–7596 Fax: (217) 782–6437

INDIANA
INDIANA STATE LIBRARY
Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204–2296
(317) 232–3679 Fax: (317) 232–3728

IOWA
UNIV. OF IOWA LIBRARIES
Govt. Publications
Washington & Madison Streets
Iowa City, IA 52242–1166
(319) 335–5926 Fax: (319) 335–5900

KANSAS
UNIV. OF KANSAS
Govt. Documents & Maps Library
6001 Malott Hall
Lawrence, KS 66045–2800
(913) 864–4660 Fax: (913) 864–3855

KENTUCKY
UNIV. OF KENTUCKY
King Library South
Govt. Publications/Maps Dept.
Patterson Drive
Lexington, KY 40506–0039
(606) 257–3139 Fax: (606) 257–3139

LOUISIANA
LOUISIANA STATE UNIV.
Middleton Library
Govt. Documents Dept.
Baton Rouge, LA 70803–3312
(504) 388–2570 Fax: (504) 388–6992

LOUISIANA TECHNICAL UNIV.
Prescott Memorial Library
Govt. Documents Dept.
Ruston, LA 71272–0046
(318) 257–4962 Fax: (318) 257–2447

MAINE
UNIV. OF MAINE
Raymond H. Fogler Library
Govt. Documents Dept.
Orono, ME 04469–5729
(207) 581–1673 Fax: (207) 581–1653

MARYLAND
UNIV. OF MARYLAND – COLLEGE PARK
McKeldin Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 405–9165 Fax: (301) 314–9416

MASSACHUSETTS
BOSTON PUBLIC LIBRARY
Govt. Documents
666 Boylston Street
Boston, MA 02117–0286
(617) 536–5400, ext. 226
Fax: (617) 536–7758

MICHIGAN
DETROIT PUBLIC LIBRARY
5201 Woodward Avenue
Detroit, MI 48202–4093
(313) 833–1025 Fax: (313) 833–0156

LIBRARY OF MICHIGAN
Govt. Documents Unit
P.O. Box 30007
717 West Allegan Street
Lansing, MI 48909
(517) 373–1300 Fax: (517) 373–3381

MINNESOTA
UNIV. OF MINNESOTA
Govt. Publications
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 624–5073 Fax: (612) 626–9353

MISSISSIPPI
UNIV. OF MISSISSIPPI
J.D. Williams Library
106 Old Gym Bldg.
University, MS 38677
(601) 232–5857 Fax: (601) 232–7465

MISSOURI
UNIV. OF MISSOURI – COLUMBIA
106B Ellis Library
Govt. Documents Sect.
Columbia, MO 65201–5149
(314) 882–6733 Fax: (314) 882–8044

MONTANA
UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812–1195
(406) 243–6700 Fax: (406) 243–2060

NEBRASKA
UNIV. OF NEBRASKA – LINCOLN
D.L. Love Memorial Library
Lincoln, NE 68588–0410
(402) 472–2562 Fax: (402) 472–5131

NEVADA
THE UNIV. OF NEVADA LIBRARIES
Business and Govt. Information Center
Reno, NV 89557–0044
(702) 784–6579 Fax: (702) 784–1751

NEW JERSEY
NEWARK PUBLIC LIBRARY
Science Div. – Public Access
P.O. Box 630
Five Washington Street
Newark, NJ 07101–7812
(201) 733–7782 Fax: (201) 733–5648

NEW MEXICO
UNIV. OF NEW MEXICO
General Library
Govt. Information Dept.
Albuquerque, NM 87131–1466
(505) 277–5441 Fax: (505) 277–6019

NEW MEXICO STATE LIBRARY
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827–3824 Fax: (505) 827–3888

NEW YORK
NEW YORK STATE LIBRARY
Cultural Education Center
Documents/Gift & Exchange Section
Empire State Plaza
Albany, NY 12230–0001
(518) 474–5355 Fax: (518) 474–5786

NORTH CAROLINA
UNIV. OF NORTH CAROLINA – CHAPEL HILL
Walter Royal Davis Library
CB 3912, Reference Dept.
Chapel Hill, NC 27514–8890
(919) 962–1151 Fax: (919) 962–4451

NORTH DAKOTA
NORTH DAKOTA STATE UNIV. LIB.
Documents
P.O. Box 5599
Fargo, ND 58105–5599
(701) 237–8886 Fax: (701) 237–7138

UNIV. OF NORTH DAKOTA
Chester Fritz Library
University Station
P.O. Box 9000 – Centennial and University Avenue
Grand Forks, ND 58202–9000
(701) 777–4632 Fax: (701) 777–3319

OHIO
STATE LIBRARY OF OHIO
Documents Dept.
65 South Front Street
Columbus, OH 43215–4163
(614) 644–7051 Fax: (614) 752–9178

OKLAHOMA
OKLAHOMA DEPT. OF LIBRARIES
U.S. Govt. Information Division
200 Northeast 18th Street
Oklahoma City, OK 73105–3298
(405) 521–2502, ext. 253
Fax: (405) 525–7804

OKLAHOMA STATE UNIV.
Edmon Low Library
Stillwater, OK 74078–0375
(405) 744–6546 Fax: (405) 744–5183

OREGON
PORTLAND STATE UNIV.
Branford P. Millar Library
934 Southwest Harrison
Portland, OR 97207–1151
(503) 725–4123 Fax: (503) 725–4524

PENNSYLVANIA
STATE LIBRARY OF PENN.
Govt. Publications Section
116 Walnut & Commonwealth Ave.
Harrisburg, PA 17105–1601
(717) 787–3752 Fax: (717) 783–2070

SOUTH CAROLINA
CLEMSON UNIV.
Robert Muldrow Cooper Library
Public Documents Unit
P.O. Box 343001
Clemson, SC 29634–3001
(803) 656–5174 Fax: (803) 656–3025

UNIV. OF SOUTH CAROLINA
Thomas Cooper Library
Green and Sumter Streets
Columbia, SC 29208
(803) 777–4841 Fax: (803) 777–9503

TENNESSEE
UNIV. OF MEMPHIS LIBRARIES
Govt. Publications Dept.
Memphis, TN 38152–0001
(901) 678–2206 Fax: (901) 678–2511

TEXAS
TEXAS STATE LIBRARY
United States Documents
P.O. Box 12927 – 1201 Brazos
Austin, TX 78701–0001
(512) 463–5455 Fax: (512) 463–5436

TEXAS TECH. UNIV. LIBRARIES
Documents Dept.
Lubbock, TX 79409–0002
(806) 742–2282 Fax: (806) 742–1920

UTAH
UTAH STATE UNIV.
Merrill Library Documents Dept.
Logan, UT 84322–3000
(801) 797–2678 Fax: (801) 797–2677

VIRGINIA
UNIV. OF VIRGINIA
Alderman Library
Govt. Documents
University Ave. & McCormick Rd.
Charlottesville, VA 22903–2498
(804) 824–3133 Fax: (804) 924–4337

WASHINGTON
WASHINGTON STATE LIBRARY
Govt. Publications
P.O. Box 42478
16th and Water Streets
Olympia, WA 98504–2478
(206) 753–4027 Fax: (206) 586–7575

WEST VIRGINIA
WEST VIRGINIA UNIV. LIBRARY
Govt. Documents Section
P.O. Box 6069 – 1549 University Ave.
Morgantown, WV 26506–6069
(304) 293–3051 Fax: (304) 293–6638

WISCONSIN
ST. HIST. SOC. OF WISCONSIN LIBRARY
Govt. Publication Section
816 State Street
Madison, WI 53706
(608) 264–6525 Fax: (608) 264–6520

MILWAUKEE PUBLIC LIBRARY
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 286–3073 Fax: (414) 286–8074

Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 377)

JUNE 26, 1998

01
AERONAUTICS

19980049061

Aircraft Division - Maintenance and upgrading capabilities

Berlowitz, Ilan, Israel Aircraft Industries, Ltd., Bedek Aviation Group, Lod, Israel; 1998, pp. 51-69; In English; Copyright; Avail: Aeroplus Dispatch

The Aircraft Division provides a comprehensive list of capabilities, including major maintenance, overhaul and repair services, structure and systems modifications, retrofits, upgrades and interior refurbishments, conversions of transport aircraft to various configurations or multimission applications, all for over 30 types of civil and special missions aircraft including Boeing 707, 727, 737, 747, 757, and 767, Douglas DC-3, DC-8, DC-9, DC-10, MD 80 series, MD11, Lockheed L-100 and C-130, Airbus A300, A310, Yakovlev Yak 40, Yak 42, Tupolev TU134, TU154, Iliushin IL-86, IL-96, LIA Westwind, Astra, and Arava aircraft. The Aircraft Division operates as an independent business plant within the Bedek Aviation Group of Israel Aircraft Industries (IAI) and has the unique advantage of being in a position to offer a one-stop service station that can supply, under one roof, total aircraft service.

Author (AIAA)

Transport Aircraft; Aircraft Maintenance; Avionics; Service Life; Military Aircraft

19980049204

On the use of the Predator (MAE-UAV) system in Bosnia

Wiedemann, Peter, U.S. Navy, Joint Strategic UAV Program Management Office, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

One of the most successful, innovative, and rapidly fielded military reconnaissance systems ever produced by the U.S. is formally known as the Medium Altitude Endurance Unmanned Aerial Vehicle (MAE-UAV), but is now widely referred to by the name of its air vehicles: Predator. Predator is a tactical reconnaissance system whose airborne platform provides high quality still and motion (video) color and gray-scale imagery of tactical targets, in daylight, at night, and through clouds, using a capable array of visible light, infrared, and SAR sensors. Predator has seen two operational deployments in support of United Nations and American operations in Bosnia-Herzegovina. The second of these is still ongoing. The use in Bosnia of high-capability, tactically controlled, real-time reconnaissance systems, of which Predator is the most widely used and leading example, has changed and is continuing to change the way imagery intelligence and operations are conducted, and the relationships between these functions. Shortcomings of the system, gleaned from its Bosnia support experience, have been and are being addressed and integrated into new procurements of Predator systems. Most or many will also be retrofitted into existing systems. An overview of the MAE-UAV (Predator) system is given. The use of the Predator system in support of operations in Bosnia is the main subject of the paper. Then, the lessons learned from the use of Predator on the battlefield are discussed.

AIAA

Pilotless Aircraft; Military Operations; Military Aircraft

19980049205

UV '97; Proceedings of the 5th International Unmanned Vehicles Conference & Exhibition, Paris, France, June 12, 13, 1997. Vols. 1 & 2

1997; In English; Vol. 1, 170 p.; vol. 2, 227 p; Copyright; Avail: Aeroplus Dispatch

Papers and chart-type presentations are presented on the applications and certification of civilian unmanned air vehicles (UAVs); UAV operational requirements and program updates, including papers on the Phoenix program and the DarkStar High

Altitude Endurance UAV; unmanned vehicles (UVs) and aerial target development programs, including a paper on the close range Hussard 2 Fog UAV development; and UAV operational experience, including papers on lessons learned in the use of Predator in Bosnia and how experience with Pioneer brought about the Shadow. Papers and chart-type presentations are also given on unmanned ground vehicles (UGVs), including a papers on the impact of reality in the architecture of mobile military robots, lessons learned in the use of UGVs during Demo II, and the robotic deployment of mine detection equipment; unmanned naval vehicles; autonomous aerial targets; and sensors, critical subsystems, and miscellaneous equipment in UVs, including a paper on the UAV mission simulator market.
AIAA
Conferences; Pilotless Aircraft; Remotely Piloted Vehicles; Surface Vehicles; Military Vehicles

19980049522
The Phoenix programme
Dennis, Ray W., GEC-Marconi Avionics, Ltd., Airport Works, UK; Aplin, J. D., GEC-Marconi Avionics, Ltd., Airport Works, UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Since the completion of the initial Customer Acceptance Trials, Phoenix has undergone a number of system improvement activities, and this paper provides the scope and results of these improvements together with a few suggestions that are under consideration for future development. It commences with a brief description of the system. An insight is then provided into the developments that have taken place in order to enhance the system from a user viewpoint. Then, an update to the flight trials position is provided, and an outline is given of some of the developments which are being considered to adapt the system to the 'Battlefield 2000' scenario.
Author (AIAA)
Pilotless Aircraft; Military Operations; Research and Development

19980049523
DarkStar - High Altitude Endurance UAV
Berman, Harry A., DARPA, HAE UAV Program Office, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the U.S. program to develop, test, and demonstrate the Tier 3 DarkStar High Altitude Endurance Unmanned Aerial Vehicle (HAE UAV). DarkStar is designed to provide continuous, timely, high-resolution imagery products to the Warfighter. DarkStar is uniquely capable of extended surveillance over heavily defended territory. DarkStar is part of the HAE UAV program which also includes the Global Hawk UAV and a common ground segment which is interoperable with both UAVs. It is the combination of DarkStar, Global Hawk, and other intelligence, surveillance, and reconnaissance assets which will provide U.S. forces with the information dominance central to future warfighting plans. DARPA is executing the program under Section 845 contracting authority. Air vehicle no. 1 completed one successful flight and had an accident on the takeoff of flight no. 2. The accident causes are now well understood. Subsystems and test procedure modifications are being implemented on air vehicle no. 2. Planning for the program's demonstration phase, FY99-00, is well underway. The U.S. Atlantic Command has been designated the lead CINC for the system's military evaluation. Specific demonstration exercises are being identified and specific data collection requirements are being developed. The entire DarkStar team is confident that it will demonstrate the performance characteristics which make this a unique and valuable system for protecting and preserving the nation's interests.
Author (AIAA)
Pilotless Aircraft; High Altitude; Military Aircraft

19980049524
Close range UAV development Hussard 2 Fog
Doste, Robert, Aerospatiale Missiles, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

In recent years, Aerospatiale has recognized the need for the development of a compact 'low cost' reconnaissance system in order to cover these future significant requirements: (1) observation and reconnaissance 'independent of topography', e.g. behind hills and mountains, in a range of approximately 10 km, (2) a real-time data link to provide images to the forward line of own troops (FLOT), (3) jamming-immune data transmission in a harsh electromagnetic environment, (4) system discretion by signature reduction, (5) recoverable reusable easy-handling air vehicles, (6) a small crew with no proficiency in aeronautics, and (7) a system operative at reduced size and cost. In order to meet these requirements, Aerospatiale has developed the HUSSARD 2 close-range Unmanned Air Vehicle (UAV) System based on three key points: a simple and light air vehicle, a powerful PC-based ground control station, and a secure data link via fiber optics. The Hussard 2 Fog UAV System is outlined in this paper, covering the air vehicle itself, the navigation and control aspects, the color-imaging CCD camera payload, the data transmission aspects, and the ground control station. The operating mode of the existing demonstration air vehicle is outlined and discussed, including

its mission preparation, takeoff, flight monitoring and navigation, real-time observation, end-of-mission routine, and post-mission evaluation. Finally, the development status of the Hussard 2 and the main operational system orientations are discussed.
AIAA
Pilotless Aircraft; Military Aircraft; Product Development

19980049525

How experience with Pioneer brought about the Shadow

Christner, Jim, AAI Corp., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper traces how experience gained from the result of over 10,000 Pioneer remotely piloted vehicle (RPV) flight hours and the experience gained during Operation Desert Shield and Operation Desert Storm led to the development of the Shadow 600 unmanned air vehicle (UAV). The major components of the Shadow 600 UAV system are discussed, including the Shadow 600 air vehicle, the Mission Planning and Control Station (MPCS), the Ground Data Terminal (GDT), and the payloads.
AIAA
Remotely Piloted Vehicles; Pilotless Aircraft; Military Aircraft; Product Development

19980049690

The Super Hornet

Tirpak, John A., USA; Air Force Magazine; Mar. 1998; ISSN 0730-6784; Volume 81, no. 3, pp. 34-39; In English; Copyright; Avail: Aeroplus Dispatch

The development history of the U.S. Navy's new F/A-18E/F Super Hornet is recounted. Emphasis is placed on the fact that the aircraft is not designed with stealth in mind, and the reasons for this.
AIAA
F-18 Aircraft; Aircraft Performance; Military Operations

19980050564

Air to air missiles development in Israel

Rosen, Dan, Rafael Armament Development Authority, Israel; 1998, pp. S9-15 to S9-32; In English; Copyright; Avail: Aeroplus Dispatch

The paper comprises a historical, technological overview of nearly forty years of air to air missile development activity at Rafael, Israel's Ministry of Defense Armament Development Authority. Since 1959, four short range infrared missile models have been developed and introduced into the Israeli Air Force arsenal, starting with the Shafrir 1, comparable in its performance to the Sidewinder Aim-9B. Next came the Shafrir 2, still a rear aspect type upgrade of the Shafrir 1, and comparable to the Sidewinder Aim-9D. Following were the Python 3, an all aspect air combat missile, and the latest model, the Python 4. The main characteristics of the missiles and the related technologies leading to them are described, and the chronological development history, with its hardships, achievements, failures and successes, is overviewed.
Author (AIAA)
Air to Air Missiles; Technology Assessment; Radar Targets; Airborne Radar; Missile Ranges

19980050566

Israel Annual Conference on Aerospace Sciences, 38th, Tel Aviv and Haifa, Israel, Feb. 25, 26, 1998, Proceedings

1998; In English; Copyright; Avail: Aeroplus Dispatch

The papers presented in this volume cover a variety of topics in aerospace sciences. These include aerodynamics and computational fluid dynamics; aeronautical design; guidance, navigation, and control; materials, structures, and aeroelasticity; and propulsion and combustion. Some specific topics discussed include guiding munitions with a micromechanical INS/GPS system; development of large solid boosters at IMI; development and validation of a one-equation turbulence model; and geometric CAD applications in aircraft design. Papers are also presented on the architecture of a novel mission controller for advanced unmanned air vehicles; discrete-time optimal guidance; buckling strength of composite lattice structures; and experimental investigation of the combustion of gel fuels.
AIAA
Conferences; Aircraft Design; Aerodynamic Characteristics; Aircraft Construction Materials; Satellite Design

19980050984

First production V-22 meets major milestone

Kandebo, Stanley W., USA; Aviation Week & Space Technology; Mar. 02, 1998; ISSN 0005-2175; Volume 14, no. 9, pp. 35, 36;

In English; Copyright; Avail: Aeroplus Dispatch

Five aircraft will make up the first lot of the V-22 tilt-rotor VTOL aircraft's 'low-rate initial production' version. An account is given to the manufacturing and assembly refinements, such as near-net-shape casting rather than machining of structural components, that are being incorporated in order to reduce the unit costs of these most up-to-date V-22s. The V-22 is to be used by all U.S. armed services.

AIAA

Japanese Spacecraft; Failure Analysis; Satellite Orbits; Domestic Satellite Communications Systems; Japanese Space Program

19980051099

Comparison of models for the wavenumber-frequency spectrum of turbulent boundary layer pressures

Graham, W. R., Univ. of Cambridge, UK; Journal of Sound and Vibration; Oct 02, 1997; ISSN 0022-460X; Volume 206, no. 4, pp. 541-565; In English; Copyright; Avail: Issuing Activity

Aircraft cabin noise due to the fuselage boundary layer is determined by, among other factors, the wavenumber-frequency spectrum of the fluctuating boundary layer pressures, a quantity for which a number of models have been proposed. In this work predictions for the sound radiated by a boundary layer driven plate are investigated, with a view to determining which model is most appropriate to the cabin noise problem. It is found that, for the structural and boundary layer parameters typical of transport aircraft, the contributions of resonant, acoustically inefficient plate modes dominate the radiated power. When these modes are strongly driven by the boundary layer, their excitation levels are determined by the 'convective peak' of the wavenumber-frequency spectrum (where most of the fluctuation energy lies), and the radiated sound is found to be sensitive to details of the shape and location of the peak, giving differing results for models normally thought to agree at this point. Otherwise, it is the sub-convective region of the wavenumber-frequency spectrum that is important, and differences between models here lead to corresponding discrepancies in radiated sound predictions. Since the first case is generally more problematic, one can conclude that a suitable model must above all describe the convective peak accurately; however, the extent to which existing alternatives do so remains unclear.

Author (EI)

Frequency Distribution; Turbulent Boundary Layer; Noise (Sound); Aircraft Compartments; Fuselages; Boundary Layers; Spectrum Analysis

19980051596

Boeing unveils stealth standoff missile design

Fulghum, David A., USA; Aviation Week & Space Technology; Mar. 09, 1998; ISSN 0005-2175; Volume 148, no. 10, pp. 56; In English; Copyright; Avail: Aeroplus Dispatch

The Joint Air-to-Surface Standoff Missile (JASSM) has six control surfaces that can be folded in various combinations to allow either internal or external carriage by aircraft as different as the B-2 and F-117. The projected unit price of this stealth weapon, which is suggested to have a range as great as 225-250 miles, is $400,000. The performance levels that are to be demonstrated by the JASSM test program are discussed.

AIAA

Air to Surface Missiles; Weapons Delivery; Missile Design

19980051702

Turning up the heat on aircraft structures

Dobyns, Alan, Sikorsky Aircraft, USA; Saff, Charles, McDonnell Aircraft Co., USA; Johns, Robert, NASA Lewis Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 343-348; In English; Copyright; Avail: Aeroplus Dispatch

Current trends in designing structures for helicopters and subsonic, supersonic, and hypersonic fixed-wing aircraft are reviewed. Today's shift from the principle of best performance at low cost to that of lowest cost for good performance creates new thrusts in four areas: integrated design, in which cost weighs as heavily as any other parameter; improved design analysis tools; low-cost fabrication techniques; and more sophisticated test methods. The primary emphasis of this effort is to produce low-cost structures in minimum time while assuring performance, integrity, and supportability. Three-dimensional CAD/CAM data are becoming the language through which design, manufacturing, and engineering communicate. These trends are illustrated by examining some specific structural design problems and their solutions. The examples include the High Speed Civil Transport and the X-30 National Aerospace Plane.

AIAA

Aircraft Structures; Aircraft Design; Hypersonic Aircraft; Structural Design; Fatigue Life; Computer Aided Design

19980051705

Large vehicle concepts

Noggle, Larry W., USAF, Aeronautical Systems Div., USA; Jobe, Charles E., USAF, Flight Dynamics Lab., USA; Structures technology - Historical perspective and evolution; 1998, pp. 303-313; In English; Copyright; Avail: Aeroplus Dispatch

Some of the very large vehicle concepts recently examined by the Air Force, Navy, NASA, and industry are briefly reviewed. In particular, attention is given to conventional large aircraft with payloads fromn 110,000 to 600,000 lb and gross weights from 326,000 to 1,700,000 lb, laminar flow control aircraft, nuclear-powered aircraft, benefits from technology improvement, propfan outlook, and wing-in-ground-effect vehicles. Other concepts discussed include lighter-than-air vehicles and surface effect ships.
AIAA

Aircraft Configurations; Cargo Aircraft; Military Aircraft; Laminar Flow

19980051707

Very large vehicles - to be or ... ?

Arata, Winfield H., Jr., Northrop Corp., USA; Structures technology - Historical perspective and evolution; 1998, pp. 291-301; In English; Copyright; Avail: Aeroplus Dispatch

Prospects for the development and bringing into service new large air and surface effect vehicles are examined. Such vehicles will be made possible due to the maturing of the following technologies: fuel-efficient gas turbine engines, alternative fuels, digital avionics, composite materials and structures, advanced aluminum alloys, aerodynamic techniques and active controls, more accurate navigation systems, and meteorological instruments. The discussion covers possible military and commercial applications, existing large aircraft, trends in aircraft weight, and new large aircraft and surface effect ship concepts.
AIAA

Aircraft Performance; Gas Turbine Engines; Laminar Flow; Aircraft Design

19980051822

Mechanization/automation of major aircraft assembly tools

Bullen, George N.; Production and Inventory Management Journal; Third Quarte 01, 1997; ISSN 0897-8336; Volume 38, no. 3, pp. 84-87; In English; Copyright; Avail: Issuing Activity

The application of quick setup/flexible tooling for major aircraft assemblies has opened the door to automation and mechanization. This article is an illustration of how automation and mechanization have been applied in assembly centers where quick setup/flexible tooling are utilized. In addition, this article contains a summary of the selection criteria and the cost benefits associated with the implementation of automation and mechanization of the drilling, countersinking, sealing and fastening operations.
Author (EI)

Aircraft Industry; Manufacturing; Machine Tools; Mechanization

19980052520

Getting up to speed in hypersonic structures

Kehoe, Michael W., NASA, USA; Ricketts, Rodney H., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 349-353; In English; Copyright; Avail: Aeroplus Dispatch

Current developments in hypersonic technology focus on the X-30 National Aersopace Plane (NASP) program. The objective of this program is to demonstrate an aerospace vehicle that can take off from a runway and achieve a single-stage-to-orbit capability. The structure of the NASP will be subjected to much greater surface heating and temperature gradients than have previously been encountered. These extreme temperatures may seriously affect the structural integrity of the vehicle. The structural stability considerations, particularly aeroelastic and aeroservoelastic considerations, are examined with emphasis on the use of finite element analysis methods. The importance of an experimental database for validating the finite element analysis procedures is emphasized.
AIAA

Hypersonic Flight; Military Aircraft; Aircraft Structures; Hypersonic Vehicles

19980052911

Numerical simulation of flutter of suspension bridges

Preidikman, S., Virginia Polytechnic Inst. and State Univ., USA; Mook, D. T.; Applied Mechanics Reviews; Nov, 1997; ISSN 0003-6900; Volume 50, no. 11 pt 2, pp. S174-S179; In English; 1997 5th Pan-American Congress of Applied Mechanics, Jan. 2-4, 1997, San Juan, PR, USA; Copyright; Avail: Issuing Activity

A method for simulating the spontaneous, wind-excited vibrations of suspension bridges is described. The approach is based on a numerical model that treats the bridge and flowing air as elements of a single dynamic system; and all of the governing equations are integrated numerically, simultaneously, and interactively. It is shown that the present simulation predicts the same onset of flutter as the analysis of Fung. Unlike Fung's analysis, the present analysis provides the solution in the time domain, is not restricted to periodic motions or linear equations of motion, and provides post-onset behavior as long as the effective angles of attack are not large enough to produce stall. As a consequence, the present analysis can be a very effective tool for the design of flutter-suppressing control systems. Because the equations are solved numerically, nonlinear supports do not present a problem. In the present work, it is shown how the nonlinear springs lead to limit-cycle responses.
Author (EI)
Bridges (Structures); Flutter; Vibration Mode; Measure and Integration; Shear Stress; Wind Shear

19980053591 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Report to Congressional Committees. Navy Aviation: V-22 Cost and Capability to Meet Requirements Are Yet to Be Determined
Oct. 22, 1997; 21p; In English
Report No.(s): AD-A330847; GAO/NSIAD-98-13; B-272631; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report conveys the results of our review of the V-22 Osprey program. The program is intended to provide 523 new tilt-rotor aircraft: 425 for the Marine Corps, 50 for the Special Operations Command (SOCOM), and 48 for the Navy. Since the program began over 15 years ago, Congress has continued to provide funding, while expressing concern that the planned low rate of production is inefficient. Our objective was to review the status of the program to identify areas of potential cost increases or performance challenges and assess whether the aircraft being developed will meet the stated requirements of each of the services. We are addressing the report to the congressional committees that have jurisdiction over the matters we discuss.
DTIC
Congressional Reports; V-22 Aircraft; Cost Estimates; Tilt Rotor Aircraft

19980055126 NASA Langley Research Center, Hampton, VA USA
Synergistic Airframe-Propulsion Interactions and Integrations: A White Paper Prepared by the 1996-1997 Langley Aeronautics Technical Committee
Yaros, Steven F., NASA Langley Research Center, USA; Sexstone, Matthew G., NASA Langley Research Center, USA; Huebner, Lawrence D., NASA Langley Research Center, USA; Lamar, John E., NASA Langley Research Center, USA; McKinley, Robert E., Jr., NASA Langley Research Center, USA; Torres, Abel O., NASA Langley Research Center, USA; Burley, Casey L., NASA Langley Research Center, USA; Scott, Robert C., NASA Langley Research Center, USA; Small, William J., NASA Langley Research Center, USA; Mar. 1998; 124p; In English
Contract(s)/Grant(s): RTOP 282-10-01-01
Report No.(s): NASA/TM-1998-207644; NAS 1.15:207644; L-17723; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This white paper addresses the subject of Synergistic Airframe-Propulsion interactions and integrations (SnAPII). The benefits of SnAPII have not been as extensively explored. This is due primarily to the separateness of design process for airframes and propulsion systems, with only unfavorable interactions addressed. The question 'How to design these two systems in such a way that the airframe needs the propulsion and the propulsion needs the airframe?' is the fundamental issue addressed in this paper. Successful solutions to this issue depend on appropriate technology ideas. This paper first details some ten technologies that have yet to make it to commercial products (with limited exceptions) and that could be utilized in a synergistic manner. Then these technologies, either alone or in combination, are applied to both a conventional twin-engine transonic transport and to an unconventional transport, the Blended Wing Body. Lastly, combinations of these technologies are applied to configuration concepts to assess the possibilities of success relative to five of the ten NASA aeronautics goals. These assessments are subjective, but they point the way in which the applied technologies could work together for some break-through benefits.
Author
Airframes; Propulsion System Configurations; Technologies; Systems Integration

19980055388
Frontiers of the 'responsible imaginable' in (civilian) aeronautics
Bushnell, Dennis M., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0001; Copyright; Avail: Aeroplus Dispatch

This paper discusses future alternatives to currently deployed systems which could provide revolutionary improvements in metrics applicable to civilian aeronautics with, in many cases, significant military ’spinoff’. Specific missions addressed include subsonic transports, supersonic transports, personal aircraft, and space access. These alternative systems and concepts are in many cases updates to known ’end point’ designs enabled by recent and envisaged advancements in electronics, communications, computing, CFD/nonlinear aerodynamics and ’designer fluid mechanics’ in conjunction with a design approach employing extensive synergistic interactions between propulsion, aerodynamics, and structures.
Author (AIAA)
Aeronautics; Civil Aviation; Fluid Mechanics; Subsonic Aircraft; Wing Tips

19980055658

6-DOF enhancement of precision guided munitions testing

Siewert, Vanessa L., USAF, 39th Flight Test Squadron, USA; Sussingham, J. C., USAF, 39th Flight Test Squadron, USA; Farm, Jerome A., McDonnell Douglas Aerospace, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0396; Copyright; Avail: Aeroplus Dispatch

The Joint Direct Attack Munition (JDAM) is being developed to convert the U.S. inventory of low-drag general-purpose bombs (LDGPs) into precision guided munitions (PGMs), and modeling/simulation is playing a vital role in its design. JDAM is a strap-on tail kit assembly that uses a GPS and an INS for navigation. The tail kit has one stationary and three movable tailfins that deflect to steer the weapon to the programmed target and lift-producing strakes that increase weapon range. The GPS/INS aided tail kit can be connected to standard MK-84, MK-83, or BLU-109 bomb bodies, effectively turning dumb bombs into precision-guided munitions. Early test results have indicated that JDAM is achieving the required circular error of probability of 30 m for INS-only aided deliveries and 13 m for GPS-aided deliveries. One of the reasons for this success is the use of a 6-DOF model that accurately predicted the weapon trajectory.
Author (AIAA)
Weapon Systems; Degrees of Freedom; Bombs; Military Operations; B-52 Aircraft; Laser Guidance

19980056033

Estimating optimum hit-to-kill vehicle configurations for lethality against submunition payloads

McHenry, Michael R., Lockheed Martin Missiles & Space, USA; Levin, Michael A., Lockheed Martin Missiles & Space, USA; Orphal, Dennis L., International Research Associates, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0831; Copyright; Avail: Aeroplus Dispatch

Two simple analytical models are described for estimating the optimum lethal configuration of a hit-to-kill kinetic energy kill vehicle (KV) that is required to kill a specified threat missile submunition payload. Both models have proved useful as preliminary design tools. The ALPHA-KV analytical model is based on the simple assumptions that the KV impact crater volume in the target payload is proportional to the kinetic energy and the crater depth is equal to the hydrodynamic limit penetration. The OPTKV model uses the Tate cratering theory to determine the crater depth and diameter. Both models are found to agree well when applied to typical KV and target configurations. The models calculate the minimum mass, length, and diameter KV that can generate a crater that will overlap all of the submunitions in the target payload for both an end-on hit and a side-on hit with a defined hit-point displacement from the optimum. It was found that the optimum KV mass is inversely proportional to the square of the relative velocity, and the kinetic energy required for lethality increases approximately linearly with the hit-point displacement from the optimum. The required KV mass also increases approximately as the cube of the target payload length.
Author (AIAA)
Payloads; Missile Configurations

19980056666

Boeing refines 777-200X for critical Singapore bid

Thomas, Geoffrey, Australia; Aviation Week & Space Technology; Jan. 05, 1998; ISSN 0005-2175; Volume 14, no. 1, pp. 42, 44, 45; In English; Copyright; Avail: Aeroplus Dispatch

Boeing has completed all major design work on its 777-200X and 300X variants, in order to pursue direct competition for market share with the A340-500 aircraft in the trans-Pacific market. The competition between rival manufacturers currently centers on Singapore Airlines; the 777-200X would carry 195-200 passengers on the nonstop, all-weather operations-requiring Los Angeles-Singapore route.
AIAA
Boeing 777 Aircraft; European Airbus; Marketing; Aircraft Design; Wing Span; Seats

19980056667

Sikorsky forging ahead with S-92 program

Phillips, Edward H., USA; Aviation Week & Space Technology; Jan. 05, 1998; ISSN 0005-2175; Volume 14, no. 1, pp. 48, 49; In English; Copyright; Avail: Aeroplus Dispatch

The S-92 'Helibus' has entered a critical marketing stage, addressing a prospective 5000 medium-helicopter demand worldwide in the 2000-2019 time-frame. A key aspect of the current effort is the S-92's ability to meet stringent FAA/JAA requirements for Category A vertical takeoff and departure; these criteria address safe-landing/flight continuation after the loss of one engine by a twin-engined helicopter.

AIAA

Sikorsky Aircraft; Helicopter Design; Marketing; Aircraft Pilots; Aircraft Production; Avionics

19980056970

Medium range UAV - A success

Hamilton, W. E., Teledyne Ryan Aeronautical, USA; 1997, pp. 50-55; In English; Copyright; Avail: Aeroplus Dispatch

The use of unmanned aerial vehicles (UAVs) for reconnaissance missions of the U.S. Reconnaissance Strike Force is reviewed. The BQM-145A Medium Range UAV is employed to illustrate a UAV application for performing specific missions under adverse conditions. The vehicle successfully executed every element of a near-real-time reconnaissance mission to check the vehicle navigation system, engine, command control, telemetry, and range communications systems.

AIAA

Pilotless Aircraft; Defense Program; Technology Assessment; Bomber Aircraft

19980056971

Predator update

Ernst, Larry, General Atomics, Aeronautical Systems, USA; 1997, pp. 56-65; In English; Copyright; Avail: Aeroplus Dispatch

This is a chart presentation of Predator, including its operations and payload options, is given. Features of Predator's first and second overseas deployments are summarized along with Predator's Bosnia operations. The Predator operating costs are presented.

AIAA

Mission Planning; Predators; Data Links; Ground Based Control; Aircraft Pilots; Air Traffic Control

19980056973

The Unmanned Air Vehicle (UAV) Battlelab

Neese, Bob, USAF, UAV Battlelab, USA; 1997, pp. 78-80; In English; Copyright; Avail: Aeroplus Dispatch

The UAV Battlelab, which will conduct demonstrations to show decison makers how UAVs would directly improve military capability, save resources, and improve battlefield survivability, is discussed. The use of UAVs in the Suppression of Enemy Air Defense (SEAD), the flight of UAVs in FAA airspace, and the use of UAVs to support security forces are addressed.

AIAA

Pilotless Aircraft; Mission Planning; Military Operations; Surveillance; Cost Estimates

19980057334

Scaled's Proteus slated to fly novel missions

Scott, William B., USA; Aviation Week & Space Technology; Dec. 15, 1997; ISSN 0005-2175; Volume 147, no. 24, pp. 55; In English; Copyright; Avail: Aeroplus Dispatch

The Proteus high-altitude/long-endurance aircraft under development by Scaled Composites Inc. will be able to perform such commercial and military missions as data-relay services, reconnaissance, atmospheric research, and the launching of small satellites into LEO. The Proteus airframe is powered by two turbofans capable of operation to 60,000 ft., and features a three-section modular structure that can be tailored to suit various applications.

AIAA

High Altitude; Research Aircraft

19980057815

B-1B weapons conventionalization - A SEEK EAGLE perspective

Pixley, Greg, TYBRIN Corp., USA; Lockwood, Ken, USAF, SEEK EAGLE Office, USA; 1997, pp. 46-62; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents B-1B weapon certification programs from the Air Force SEEK EAGLE Office (AFSEO) managerial and engineering perspectives. Three methods of flight testing are used for weapon certification: endpoint demonstration, brute force, and verification. The MK-62, GBU-10/27, and the CBU-87/89/97 programs are discussed as examples of each. Engineering analysis varies for each type of program from simple analogies to complete wind tunnel programs. The HQ ACC requirements often drive and always influence the method of certification.
Author (AIAA)
B-1 Aircraft; Weapon Systems; Flight Tests; Wind Tunnel Tests

19980057822

Flight test in upgrade programs

Shafir, Yehuda, Elbit Systems, Ltd., Israel; 1997, pp. 166-182; In English; Copyright; Avail: Aeroplus Dispatch

Flight tests involved in the upgrading of airborne computers are discussed. The topics addressed include: cost effectiveness in testing, the triangulation method and the backup wire frame method of weapon separation trajectory reduction, and towed target certification.
AIAA
Flight Tests; Upgrading; Airborne/Spaceborne Computers; Cost Effectiveness; Target Acquisition

19980058134

Born-again trainer

Higdon, Dave, UK; Flight International; Nov. 04, 1997; ISSN 0015-3710; Volume 152,, no. 4598, pp. 34-37; In English; Copyright; Avail: Aeroplus Dispatch

A Calgary-based company, Alberta Aerospace, is resurrecting Stelio Frati's Jet Squalus in the form of a new, more civilian trainer, the Phoenix Fanjet. The objective is to provide a special purpose aircraft for the training of airline pilots from no experience through a jet-rated air-transport pilot (ATP) licence. Starting with the Squalus prototype will save the company millions of dollars in research and development and reduce some of the barriers and risks to the program success. Some results of Phoenix flight tests are presented.
AIAA
Training Aircraft; Aircraft Performance; Aerospace Industry

19980058361

Air power

Johns, Richard, Chief of the Air Staff, UK; Aerospace International; Jan. 1998; ISSN 0305-0831; Volume 25, no. 1, pp. 18-23; In English; Copyright; Avail: Aeroplus Dispatch

The past, present, and future of the Royal Air Force is discussed with emphasis on the UK's need for an air superiority capability. The past history of RAF is examined within the political context, with attention given to lessons learned. The current equipment program is briefly reviewed, and the need to maintain the investment in advanced technology in order to guard against the risk of a re-emergent major threat is emphasized.
AIAA
Aircraft Equipment; Fighter Aircraft; Military Operations; Technology Assessment

19980058943

Reflections on the missions and operational scenarios for hypersonic craft

Cazin, Ph., ONERA, France; ONERA, TP no. 1997-66; 1997; In English
Report No.(s): ONERA, TP no. 1997-66; Copyright; Avail: Aeroplus Dispatch

The advantages of atmospheric propelled hypersonic flight are examined for a few military applications, such as: long-range ground or surface attack missiles for which high speeds improve defence penetration capabilities; reconnaissance and surveillance drones; very high speed air-to-air missiles capable of intercepting ballistic missiles during the boosted phase or high value air targets at long range; long-range ground or surface-to-air defense systems; and faster, more flexible access to space, particularly in times of crisis. Two aspects of the problem are examined: the superiority that the possession of such hypersonic craft will give NATO by evaluating their advantages and drawbacks by comparison with systems using other technological approaches, and the threats that enemies with such craft could exercise against NATO.
Author (AIAA)
Hypersonic Vehicles; Military Aircraft; Mission Planning

19980058946

The simple science of flight - From insects to jumbo jets

Tennekes, Henk, Amsterdam, Free Univ., Netherlands; 1997; In English; ISBN 0-262-20105-4; Copyright; Avail: Aeroplus Dispatch

The book provides an introduction to the mechanics of flight and fundamentals of aeronautical engineering, drawing a parallel between nature and technology. Written in a popular style, the book contains a few formulas and simple calculations. Flight data are presented for the Boeing 747 and some other aircraft, as well as for a variety of birds.

AIAA

Aerodynamics; Aeronautics

19980059944

Aerodynamic interference between two boats sailing close-hauled

Caponnetto, Mario, Univ. of Genoa, Italy; International Shipbuilding Progress; Sep, 1997; ISSN 0020-868X; Volume 44, no. 439, pp. 241-256; In English; Copyright; Avail: Issuing Activity

Two boats are subjected to aerodynamic interference when sailing close-hauled. The sail and their wakes reciprocally interfere with each other, modifying the surrounding aerodynamic pressure field and consequently the amount of driving force produced. A program based on the vortex lattice method, suitable for considering the interference of multiple lifting surfaces is developed. The modeling of wake stream lines is discussed, as their path greatly affects the surrounding pressure field. A sample case is studied on two America's Cup Challengers systematically analyzing a wide range of reciprocal positions.

EI

Aerodynamic Interference; Pressure Distribution; Vortex Lattice Method; Aerodynamics; Vortices; Wakes

19980060768

Numerical simulation of the ground effect using the boundary element method

Kikuchi, Katsuhiro, Science Univ. of Tokyo, Japan; Motoe, Fuminori; Yanagizawa, Mitsunori; International Journal for Numerical Methods in Fluids; Nov 15, 1997; ISSN 0271-2091; Volume 25, no. 9, pp. 1043-1056; In English; Copyright; Avail: Issuing Activity

As is well known, the lift of a wing passing over the ground becomes larger than that of a wing in a finite air field because of the ground effect. Owing to its special aerodynamic characteristics and applications, the problem of the ground effect has become increasingly common. In this paper some investigations were conducted to calculate the unsteady aerodynamic forces for long and short ground plates by means of boundary element techniques. In order to calculate the pressure variation on a long ground plate, the steady boundary element method was used. However, when using a short ground plate, the boundary element method was modified to treat the unsteady aerodynamic phenomena. Experimental studies were also made for both ground plates to confirm the validity of the numerical results. At low angles of attack the qualitative behavior of the unsteady aerodynamic pressure on both ground plates was well predicted by the boundary element methods and qualitative agreement is found between the calculated and measured results.

Author (EI)

Boundary Element Method; Ground Effect (Aerodynamics); Computerized Simulation; Pressure Effects; Computation

19980061421

Development of a hidden fire challenge

Chattaway, Adam, Kidde Int., UK; Fire and Materials; Sep-Oct, 1997; ISSN 0308-0501; Volume 21, no. 5, pp. 219-228; In English; Copyright; Avail: Issuing Activity

A replacement agent must be found for Halon 1211, the production of which ceased on January 1, 1994 in accordance with the Montreal Protocol. The Aviation Authorities require that 'no loss of safety' should occur in the replacement agents. Six Halon replacements - FM-200, FE-25, CEA-4.10, CEA-6.14, FE-36, and Triodide, were tested using apparatus designed to give a constant discharge time. The rates of extinguishment were similar to Halon 1211, provided the quantity of agent is scaled according to its n-heptane cupburner concentration, except for FR-25 and CEA-6.14 with markedly different volatilities.

EI

Aircraft Safety; Flame Retardants; Fire Extinguishers; Transport Aircraft; Flames

19980062186

Nipping noise in the bud

Hitchcox, A. L.; Hydraulics & Pneumatics; Oct, 1997; ISSN 0018-814X; Volume 50, no. 10, pp. 77-78; In English; Copyright; Avail: Issuing Activity

One of the greatest challenges in the workplace area is that of making machines quieter without adding substantially to their cost. At present, a number of techniques exist to reduce pump ripple, and consequently, its detrimental effects. The most important would be a technique that can reduce the generation of noise at its source.

EI

Hydraulic Equipment; Pumps; Pressure Effects; Vibration Damping

19980062815

Yak-42 - Buyer's options ***Yak-42 - Komponovka - po zhelaniyu zakazchika***

Khlapin, Anatolij, OAO 'OKB im. A.S. Yakovleva', Russia; Grazhdanskaya Aviatsiya; Jul. 1997; ISSN 0017-3606, no. 7, pp. 16, 17; In Russian; Copyright; Avail: Aeroplus Dispatch

Recent improvements to the Yak-42 passenger aircraft, and its new version, Yak-42A, are briefly reviewed. The improvements include an increased flight range, better passenger comfort, and updated piloting and navigation equipment. Also, the aircraft can now be fully customized by selecting the desired equipment from a wide variety of available options.

AIAA

Passenger Aircraft; Flight Optimization; Aircraft Equipment; Navigation Instruments

19980062818

The all-purpose mountainous-terrain aircraft AN-32 and its modifications ***Vysokogornyj universal–An-32 i ego modifikatsii***

Boboshin, Nikolaj, Russia; Kryl'ya Rodiny; 1997; ISSN 0130-2701, no. 6, pp. 1-3; In Russian; Copyright; Avail: Aeroplus Dispatch

The An-32 STOL transport is designed for carrying 50 passengers, 42 paratroopers, or 24 stretchers over short and medium distances. The An-32 can be operated under extreme meteorological and climatic conditions, at any time of day and night, and at ambient temperatures up to +45 C; it is ideally suited to operation over mountainous terrain. The principal technical and performance characteristics of An-32 and its predecessor, An-26, are summarized.

AIAA

Antonov Aircraft; Aircraft Design; Passenger Aircraft; Aviation Meteorology; Mountains; Flight Characteristics

19980063984

Fluid flow-induced nonlinear vibration of suspended cables

Chang, W. K., Wayne State Univ., USA; Pilipchuk, V.; Ibrahim, R. A.; Nonlinear Dynamics; Dec, 1997; ISSN 0924-090X; Volume 14, no. 4, pp. 377-406; In English; Copyright; Avail: Issuing Activity

The nonlinear interaction of the first two in-plane modes of a suspended cable with a moving fluid along the plane of the cable is studied. The governing equations of motion for two-mode interaction are derived on the basis of a general continuum model. The interaction causes the modal differential equations of the cable to be non-self-adjoint. As the flow speed increases above a certain critical value, the cable experiences oscillatory motion similar to the flutter of aeroelastic structures. A co-ordinate transformation in terms of the transverse and stretching motions of the cable is introduced to reduce the two nonlinearly coupled differential equations into a linear ordinary differential equation governing the stretching motion, and a strongly nonlinear differential equation for the transverse motion. For small values of the gravity-to-stiffness ratio the dynamics of the cable is examined using a two-time-scale approach. Numerical integration of the modal equations shows that the cable experiences stretching oscillations only when the flow speed exceeds a certain level. Above this level both stretching and transverse motions take place. The influences of system parameters such as gravity-to-stiffness ratio and density ratio on the response characteristics are also reported.

Author (EI)

Fluid Flow; Vibration Mode; Hydrodynamics; Mathematical Models; Equations of Motion

19980065400

The family value turboprop

Baldwin, Bernie, UK; Aerospace International; Feb. 1998; ISSN 0305-0831; Volume 25, no. 2, pp. 24-26; In English; Copyright; Avail: Aeroplus Dispatch

The recent roll-out of the de Havilland Dash 8Q-400, the largest aircraft ever built by de Havilland, is discussed in the context of the current status of the regional aircraft industry. The aircraft provides a solution to the key issues of noise and vibration ('Q' stands for 'quiet') by using the new NVS (noise and vibration suppression) system. The system employs active tuned vibration absorbers (TVAs) placed at optimum positions on the airframe to remove the major source of vibration and noise. The engine choice is the Pratt & Whitney Canada PW150A; the engines will drive six-bladed Dowty propellers and provide a cruise speed of 648 km/h.
AIAA
Turboprop Aircraft; De Havilland Aircraft; Aircraft Design; Product Development; Aircraft Production

19980067155

The Power of delight

Cowan, Rory, UK; Helicopter World; Dec. 1997; ISSN 0262-0448; Volume 16, no. 9, pp. 6-9; In English; Copyright; Avail: Aeroplus Dispatch

The Agusta 109's new 'Power' variant, which employs a four-blade rotor, is configured for use in such roles as police operations, search-and-rescue, medical evacuation, electronic news gathering, corporate transport, and offshore platform servicing. The present flight test evaluation notes that the Power exhibits excellent handling qualities and cockpit comfort.
AIAA
Helicopter Design; Light Helicopters; Rotary Wings

19980067605

Aged to perfection?

Higdon, Dave, UK; Flight International; Oct. 14, 1997; ISSN 0015-3710; Volume 152,, no. 4595, pp. 38, 39, 41; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation is made of production techniques and flight qualities, in search of reasons for the continued popularity of the 50-year-old Bonanza private aircraft design. The flight-tested aircraft is equipped with a turbocharged engine, and can carry four adults with luggage in addition to the pilot. Attention is given to the range of options currently available.
AIAA
General Aviation Aircraft; Aircraft Design

19980067606

Persistent ambitions

Warwick, Graham, UK; Flight International; Oct. 21, 1997; ISSN 0015-3710; Volume 152,, no. 4596, pp. 36, 37; In English; Copyright; Avail: Aeroplus Dispatch

The USAF and DARPA have begun to aggressively plan the development of uninhabited combat air vehicles (UCAVs), foreseeing technology-demonstrator trials as soon as 2001. UCAVs are high performance military aircraft carrying advanced munitions that are deployed by highly autonomous control systems; costs are expected to be half those of existing fighters, and operating and supports costs may be an order of magnitude lower.
AIAA
Remotely Piloted Vehicles; Fighter Aircraft

19980067609

Bell 427 nears first flight

Phillips, Edward H., USA; Aviation Week & Space Technology; Nov. 24, 1997; ISSN 0005-2175; Volume 147, no. 21, pp. 65; In English; Copyright; Avail: Aeroplus Dispatch

The eight-seat Bell Helicopter Textron Model 427 is the first new twin-engine lightweight helicopter to be developed as a joint venture with a foreign firm, in this case South Korea's Samsung Aerospace. The 427's engines are equipped with full authority digital electronic control. Most of the 70 orders thus far received are from European operators.
AIAA
Helicopter Design; Aircraft Models; Flight Tests; Bell Aircraft

19980067623

At the Moscow Air Show - Ukraine takes flight

Possehl, Suzanne, USA; Aerospace America; Jan. 1998; ISSN 0740-722X; Volume 36, no. 1, pp. 4-6; In English; Copyright; Avail: Aeroplus Dispatch

A survey is made of the current organizational plans, economic prospects, and primary products of the Ukrainian aerospace industry, which had undergone a period of uncertainty and financial distress since gaining independence from Russia at the end of the Soviet period. The strongest components of Ukrainian aerospace are guidance systems, advanced welding techniques, and radio astronomy.
AIAA
Ukraine; Aerospace Industry; Space Programs

19980067627

ERAST program marks early successes

Baer-Riedhart, Jennifer, NASA, USA; Aerospace America; Jan. 1998; ISSN 0740-722X; Volume 36, no. 1, pp. 36-38, 41, 42; In English; Copyright; Avail: Aeroplus Dispatch

A development status evaluation is presented for the NASA Environmental Research Aircraft and Sensor Technology (ERAST) program, which has begun science mission flight demonstrations. ERAST, which involves intensive partnering between government and industry, has developed the Pathfinder remotely-piloted aircraft, which employs an electromechanical propulsion system fed powered by solar cells to fly as slowly a 15 mph at altitudes as high as 100,000 ft. ERAST is aggressively oriented toward advanced-technology spinoffs.
AIAA
Research Aircraft; Environmental Monitoring; Government/Industry Relations; Remotely Piloted Vehicles; Remote Sensors

19980067650

AIAA/IEEE Digital Avionics Systems Conference (DASC), 16th, Irvine, CA, Oct. 26-30, 1997, Proceedings. Vols. 1 & 2

1997; In English; Vol. 1, 675 p.; vol. 2, 586 p; ISBN 0-7803-4150-3; Copyright; Avail: Aeroplus Dispatch

The present conference discusses topics in the fields of software engineering with legacy software, software architectures and design techniques, software tools and environments, software testing and validation, multichip module implementation for spacecraft, microscience instrumentation for next-generation small spacecraft, electronic packaging interaction with small spacecraft, commercial and military integrated avionics systems, avionics networks, open avionics systems, the susceptibility of aircraft avionics, and electromagnetic effects. Also discussed are avionics-testing techniques and facilities, electromagnetic mitigation engineering, avionics safety assessment and fault analysis avionics test methods and facilities, RF and electrooptic/IR sensors, computer processors, computer data fusion, computer visualization technology, aviation system architectures, economic value and cost analysis techniques, human/machine interface, cockpit systems and displays, vehicle-management systems, fly-by-light and power-by-wire techniques, space avionics, spacecraft modeling and simulation, low cost avionics for expendable launch vehicles, advanced avionics for manned spaceflight, 'free flight' air traffic management, pilot decision-support tools, and navigational conflict-detection systems.
AIAA
Conferences; Avionics; Digital Techniques

19980067791

Free flight - An air traffic management partnership

Ball, John W., Sr., Lockheed Martin Aeronautical Systems, USA; 1997, pp. 9.1-9 to 9.1-15; In English; Copyright; Avail: Aeroplus Dispatch

It is generally recognized that an air traffic management system involving free flight throughout NAS presents the opportunity to safely increase system productivity. The Lockheed Martin team has developed an enabling vision for free flight referred to as Air Traffic Management Partnership (ATMP), offering the ability to realize the full potential of free flight. Our approach focuses on a reallocation of responsibilities among the principal operators of the airspace system, namely, pilots on the flight deck, managers working for the Air Traffic Service Provider (ATSP), and dispatchers working in the Airline Operations Center (AOC). ATMP is a cooperative system of modern technologies to realize a balanced allocation of responsibility and resources for increased safety, efficiency, and capacity of the global airspace complex.
Author (AIAA)
Free Flight; National Airspace System

19980068019

Merlin faces final trials

Donaldson, Peter, UK; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 8-10, 12, 13; In English; Copyright; Avail: Aeroplus Dispatch

This article describes the final team preparations for the Operational Performance Acceptance Procedures (OPAP) trials of the British Royal Navy's new Merlin helicopter and its weapons system. The OPAP trials will take place on various ranges during 1998-2000 using aircraft flown by Royal Navy crews. The results of these trials will prove whether Merlin will perform to the Royal Navy's requirements, as Lockheed Martin has promised. In particular, the sonar trials are described.
AIAA
Helicopter Design; Weapon Systems; Helicopter Performance; Electronic Countermeasures

19980068020
Return to identicality
Marsh, George, UK; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 14-17; In English; Copyright; Avail: Aeroplus Dispatch

The USA Marine Corps (USMC) has contracted Bell Helicopter Textron to remanufacture its fleet of 100 UH-1N utility helicopters and 180 AH-1W Super Cobra attack helicopters to advanced configurations featuring common engines and flight dynamics. The upgraded aircraft will share basically the same GE T700 engines, a four-blade composite hingeless bearingless main rotor, tail rotor, identical drive trains, hydraulics and electrical system components. The UH-1N will gain twice the range and more than double the payload capacity. The AH-1Ws will have 30 percent more power, carry twice the load of precision-guided munitions, and have triple their present mission radius. This article discusses these developments.
AIAA
Military Helicopters; Helicopter Performance; Helicopter Design

19980068021
Cat with sharper claws
Masey, James, UK; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 18-20, 22; In English; Copyright; Avail: Aeroplus Dispatch

The Search Optronic Combat Anti-Tank (SOCAT) system will be fitted to both of Romania's combat-configured helicopters: the AH-1RO Dracula, a dedicated attack helicopter, and the multipurpose armed helicopter, the SOCAT IAR-Puma 330. The design features, avionics, and communication and navigation features which will result from the upgrading of the IAR-Puma 330 helicopter program are discussed.
AIAA
Military Helicopters; Helicopter Design; Avionics; Antitank Missiles

19980068024
Battle to replace the Deer
Gordon, Yelim, UK; Komissarov, Dmitri; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 34-39; In English; Copyright; Avail: Aeroplus Dispatch

This article describes the history of the competition between the Soviet Mil Design Bureau and the Soviet Union's other leading helicopter designer, Kamov in designing and testing an attack helicopter as a successor to the big and heavy Soviet double-purpose (attack and heavy-lift) helicopters, such as the Mi-24. The resulting designs, Mil's Mi-28 and its competition, Kamov's Ka-50, are discussed and compared.
AIAA
Military Helicopters; Helicopter Design

19980068283
Takeoff into the future ***Takeoff in die Zukunft***
DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 2-9; In German; Copyright; Avail: Aeroplus Dispatch

Research on the aircraft of the future taking place at DLR Braunschweig is discussed. Attention is given to work being conducted on the optimization of aircraft flight characteristics, the development of aerodynamic design procedures, and the development of advanced test facilities.
AIAA
Aerodynamics; Computerized Simulation; Aircraft Design; Research and Development; Aeronautics; Man Machine Systems

19980068737
A quantitative evaluation of DMMH/FH Index (airfield level) for military aircraft
Qi, Yanjie, Air Force College of Engineering, China; Huang, Kuanzhan, Air Force College of Engineering, China; Li, Jialin, Air

Force College of Engineering, China; Li, Liren, Air Force College of Engineering, China; Zhao, Tieying, Air Force College of Engineering, China; 1997, pp. 460-462; In English; Copyright; Avail: Aeroplus Dispatch

This paper studies the method of quantitative evaluation of DMMH/FH index (airfield level), a maintenance parameter of military aircraft, by means of reasonable planning airfield maintainability data acquisition and data collecting and processing. A brief account is given of the sufficiency and validity of the collected data on maintainability and also of the statistical processing of the data. A spoon-shaped curve is presented as the result of the statistical breakdown of the data about a type of fighter, which reveals the fundamental law governing the development of the statistics of abovementioned parameter of many aircraft. Direct maintenance man-hours per flight hour at airfield level (DMMH/FH) for military aircraft is an important index in aircraft maintenance management and is therefore taken seriously by both developed and developing countries in their maintainability engineering efforts. DMMH/FH is a comprehensive measurement of maintenance and management which embodies the level of maintenance design, quality of personnel, class of maintenance equipment, rationability of maintainability program, standard of maintenance organization and management, etc. Major elements affecting quantitative evaluation of the index are choice of sample aircraft, collection of first-hand data, and data handling procedures.
Author (AIAA)
Military Aircraft; Aircraft Maintenance

19980068741
The computer simulation for a bombing trajectory
Xu, Guoqiang, Air Force, First Aeronautical Inst., China; Cha, Guoyun, Air Force, First Aeronautical Inst., China; Shen, Weizhong, Air Force, First Aeronautical Inst., China; Pan, Maoqing, Air Force, First Aeronautical Inst., China; Zen, Zhenhua, Air Force, First Aeronautical Inst., China; 1997, pp. 481-485; In English; Copyright; Avail: Aeroplus Dispatch

A four-module solution Runge-Kutta method is adopted to replace the conventional approximate calculation method. A progressive regression algorithm is used to simulate the trajectory parameters calculated by the Runge-Kutta method, and a mathematical model of the real-time work formula for a bomb's trajectory is established. This results in a new kind of work formula which is more accurate and can be used in real time for calculating trajectory parameters of bombs on airborne computers and airborne HUDs.
Author (AIAA)
Runge-Kutta Method; Trajectory Analysis; Regression Analysis; Bombs (Ordnance)

19980069600
Design procedures and analysis of turbine rotor fragment hazard containment
Mathis, J. A., Wichita State Univ., USA; 1997; In English
Contract(s)/Grant(s): DTFA03-92-C-00044
Report No.(s): DOT/FAA/AR-96/121; Copyright; Avail: Aeroplus Dispatch

Containment design procedures are reviewed through an extensive literature summary that spans 23 years of research from 1970 to 1993. Sixty-four reports are summarized and cross-referenced to provide a useful bibliography on the subject. Comments from industry and government agencies are included along with a study of existing analytical methods. These analytical methods have substantiated that system-level engine and nacelle evaluations are research areas that require future development and standardization.
Author (AIAA)
Design Analysis; Fragmentation; Turbines; Rotors; Containment; Operational Hazards

19980069693 National Academy of Sciences - National Research Council, Washington, DC USA
Aging of US Air Force Aircraft ***Final Report***
Jan. 1997; 119p; In English
Report No.(s): AD-A330900; NMAB-488-2; ISBN 0-309-05935-6; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The U.S. Air Force requested the National Research Council to identify Research and Development (R&D) needs and opportunities to support the continued operation of their aging aircraft. Specifically, this study focuses on aging aircraft structures and materials and has the major objectives of 1. developing an overall strategy that addresses the Air Force aging aircraft needs 2. recommending and prioritizing specific technology opportunities in the areas of fatigue, corrosion fatigue, and stress corrosion cracking corrosion, prevention and mitigation, nondestructive inspection maintenance and repair, failure analysis and life prediction methodologies. The approach that the committee took to accomplish this study was to conduct working sessions to identify

current aging aircraft problems and technology needs; review ongoing and planned aging aircraft R&D efforts by the Air For ce; and review related research at other government agencies, within industry and in the academic research community.
DTIC
Aircraft Structures; Life (Durability); Aging (Materials); Armed Forces; Attack Aircraft

19980070217

Power to save

Peruzzi, Luca, UK; Helicopter World; Oct. 1997; ISSN 0262-0448; Volume 16, no. 7, pp. 6-8; In English; Copyright; Avail: Aeroplus Dispatch

A performance capabilities evaluation is presented for the Agusta 109 'Power' variant, which is dedicated to emergency medical services. This variant offers the widest and tallest cabin of any helicopter in its class despite having the smallest frontal area, and can operate from confined helipads at maximum weight loading.
AIAA
Helicopter Performance; Cockpits; Passenger Aircraft; Cost Reduction; Helicopter Design

19980070218

A lesson well learnt

Masey, James, UK; Helicopter World; Oct. 1997; ISSN 0262-0448; Volume 16, no. 7, pp. 12, 14, 15; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the performance capabilities of a Health and Usage Monitoring System (HUMS), 'NuHums', which has been chosen for use by the Boeing 609 tilt-rotor VTOL aircraft. NuHums uses a modular, lightweight design to perform all signal-processing in flight; a HUMS's ability to prevent mechanical failure accidents becomes critical in the context of tilt-rotor operations.
AIAA
Helicopter Performance; Aircraft Accidents; Structural Failure; Software Development Tools; Accident Prevention

19980070219

Bristow flies FLIR 4000

Donaldson, Peter, UK; Helicopter World; Oct. 1997; ISSN 0262-0448; Volume 16, no. 7, pp. 19-21; In English; Copyright; Avail: Aeroplus Dispatch

The Ultra 4000 forward-looking IR (FLIR) for helicopter search-and-rescue operations uses automated search modes to significantly reduce operator workload. When the FLIR operator finds a target, he goes over to manual control to keep track of it, allowing the helicopter to be guided at ranges below the radar minimum.
AIAA
Helicopter Control; Synthetic Aperture Radar; Infrared Imagery; FLIR Detectors; Cockpits; Flight Crews

19980070284

Express information service

Baldwin, Bernie, UK; Aerospace International; Oct. 1997; ISSN 0305-0831; Volume 24,, no. 10, pp. 20-22; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation is conducted of one of the entrants in the UK MOD's Airborne Standoff Radar program competition, the Raytheon Asars 2 advanced SAR system. The new Asars 2 antenna is intended to yield increased moving target indicator performance; data from the radar are processed and exploited in near-real time.
AIAA
Military Aircraft; Radar Imagery; Information Systems; Moving Target Indicators; Aircraft Power Supplies; Aircraft Design

19980070855

Survival and Flight Equipment Association (Europe) Symposium 1997 - The basis for material selection for use in oxygen service

Court, Simon E. C., South Bank Univ., UK; Nolan, Philip F., South Bank Univ., UK; Davis, Alex, MOD, Directorate of Military Aircraft Projects, UK; Scanlan, Geoff, Meggitt Avionics, UK; 1997, pp. 479-487; In English; Copyright; Avail: Aeroplus Dispatch

General design requirements for aircraft oxygen systems and equipment, British Standard BS 3N:100 provides guidance on material selection for use in oxygen service. This guidance takes the form of the provision of the maximum working pressure at 90 C for each material, based on its spontaneous ignition temperature, which has been measured at 13.2 MPa. A method of support-

ing the information provided by the standard has recently been devised and is based on theoretical considerations. The predictions using the method give a clear indication of the safety margins for a larger range of working conditions, in terms of both oxygen pressure and temperature. Data acquired from the use of a theoretical approach has been successfully compared with experimental data gained in a high pressure oxygen bomb on material behavior at oxygen pressures up to 69 MPa. The bomb assembly provides repeatable and reliable ignition temperature data for single substances (solids and liquids) and composites, so that whole assemblies can be evaluated. The acquisition of highly reliable ignition data combined with the existing, inherent safety margin introduced by the definition of the spontaneous ignition temperature means that a clearer picture of operating margins can be seen.
Author (AIAA)
Aircraft Equipment; Oxygen Supply Equipment; Survival Equipment; Ignition Temperature; Flight Safety; Materials Tests

19980070856

Introduction to the Joint Service aircrew systems Guide Specification

Schroll, Dennis W., USAF, Aeronautical Systems Center, USA; 1997, pp. 488-499; In English; Copyright; Avail: Aeroplus Dispatch

The purpose of this panel was to facilitate a complete industry review of the Joint Service Guide Specification (JSGS) and supporting handbooks for the aircrew systems development process. This review by SAFE Association members will complement the industry review by the Aerospace Industries Association chaired by Doug Swanson, Boeing (Seattle). Many SAFE Association industry members and participants work in the area of crew systems and life support. Some of the guide specification documents have much background information in the life-support area. After briefings were given describing the goals of the JSGS development, these documents were made available for those industry participants to review and comment. It should be noted that the documents are also currently undergoing comprehensive discussion with Army, Navy and Air Force experts. More information is expected primarily from the Navy.
Author (AIAA)
Flight Crews; Life Support Systems; Handbooks; Aeronautical Engineering; Aircraft Industry

19980070888

A stillborn monster - The TU-85 long-range bomber ***Mertvorozhdennyj monstr - Dal'nij bombardirovshchik TU-85***

Yakubovich, Nikolaj, Russia; Kryl'ya Rodiny; 1997; ISSN 0130-2701, no. 2, pp. 3-5; In Russian; Copyright; Avail: Aeroplus Dispatch

The TU-85 was conceived as an intercontinental bomber under a program, initiated in 1949 in the Soviet Union, to develop a strategic bomber capable of delivering nuclear bombs overseas. The first test flight was carried out in January 1951. Soon afterwards, however, it became obvious that the newly designed bomber, with its piston engines, was already obsolete and would be extremely vulnerable to the air defence system of the possible foe. Even as the TU-85 was being developed, work started on a new bomber, TU-95, equipped with turboprop engines. Only two TU-85 prototypes were ever produced before the project was scrapped in January 1952 in favor of the TU-95.
AIAA
Tupolev Aircraft; Aircraft Design; Bomber Aircraft; Flight Tests; Turboprop Engines

19980070889

The medium-range favorite - The TU-134 passenger aircraft. II ***Favorit na srednikh distantsiyakh - Passazhirskij samolet TU-134. II***

Rigmant, Vladimir, Russia; Kryl'ya Rodiny; 1997; ISSN 0130-2701, no. 5, pp. 28, 29; In Russian; Copyright; Avail: Aeroplus Dispatch

Versions of TU-134 aircraft designed for various special applications are briefly reviewed. In particular, attention is given to the TU-134SKh, designed as a flying laboratory for agricultural applications. The aircraft was equipped with modern remote sensing and navigation equipment operating in the radio-frequency, visual, and infrared ranges. Another version, TU-134Sh (initially designated TU-134Uch) was designed for the training of navigators for long-range civilian and military aviation. The principal technical and performance characteristics of these and other modifications of the TU-134 are presented.
AIAA
TU-134 Aircraft; Passenger Aircraft; Aircraft Design; Radio Equipment; Infrared Instruments

19980070891

Il-96M/T - The contract is signed, aircraft delivery to Aeroflot to follow ***Il-96M/T - Kontrakt podpisan, ostalos' glavnoe - vydat' samolet 'Aehroflotu'***

Shitov, V., Russia; Grazhdanskaya Aviatsiya; Mar. 1997; ISSN 0017-3606, no. 3, pp. 6-9; In Russian; Copyright; Avail: Aeroplus Dispatch

Under a newly signed contract, twenty new Il-96M/T widebody aircraft are soon to be delivered to Aeroflot, first in the cargo version (T) and then in the passenger version (M). The passenger version of the aircraft can carry 309-416 passengers in comfort and is designed to operate on domestic and international routes up to 11,500 km long. The cargo version, Il-96T can carry up to 92 tons of cargo to distances up to 14,000 km. The principal design features of the Il-96M/T aircraft are summarized.

AIAA

Passenger Aircraft; Aircraft Design; Contracts; Cargo Aircraft; Aircraft Performance

19980071160

Merciful serpent

Cowan, Rory, UK; Helicopter World; Nov. 1997; ISSN 0262-0448; Volume 16, no. 8, pp. 6-9; In English; Copyright; Avail: Aeroplus Dispatch

The Polish W-3 Anaconda twin-turboshaft helicopter, which is optimized for the search-and-rescue missions, is evaluated for flight handling qualities and performance capabilities. Attention is given to hover and descent characteristics.

AIAA

Rescue Operations; Helicopter Design; Helicopter Performance

19980071217

FAA, Airworthiness Assurance R&D Branch - 1996 research accomplishments

1997; In English; Copyright; Avail: Aeroplus Dispatch

Various papers on airworthiness assurance R&D in 1996 are presented. The general topics addressed are: advanced materials research, crashworthiness, propulsion systems and fuels, aging aircraft, and catastrophic failure prevention. Anong the papers on aging aircraft, which constitutes the bulk of the volume, are: antisymmetric buffet loads on horizontal stabilizers, analysis of ground-flight loads measured on a B-727, eddy current probe design for edge effect reduction, air-couple C-scan of Boeing repair coupon, modeling ultrasonic inspectability in forgings, eddy current probe design, fatigue crack initiation and growth in riveted specimens, economical eddy current, eddy current methods for crack detection, eddy current methods for corrosion detection, self-compensating ultrasonic technique, self-focusing ultrasonic system, and quantitative thermal wave imaging of corrosion thinning. Also considered are: corrosion and corrosion fatigue of airframe materials, fracture testing of large-scale thin sheet aluminum alloy, validation of the magneto-optic/eddy-current imager, automated inspection of aircraft, axial crack propagation and arrest in a pressurized fuselage, introduction of bonded composite doublers to commercial aircraft, visual inspection research project report on benchmark inspections, and the role of fretting fatigue on aircraft rivet hole cracking.

AIAA

Conferences; Research and Development; Aircraft Reliability

19980072146

Maintenance support system simulation in the operation of a civilian airplane

Du, Zhigang, Beijing Univ. of Aeronautics and Astronautics, China; Sheng, Yixing, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 420-424; In Chinese; Copyright; Avail: Aeroplus Dispatch

The maintenance support simulation system (MSSS) of civilian airliners (CAs) and the relationship between MSSS and the macro-CA system of reliability, maintainability and economy (RME) simulation is discussed. The present focus is on the MSSS modeling and design of the CARMES function module. Finally, the Y-7 CA of an airline in China is selected as a case study to show the analysis and accessing of RME of CAS.

Author (AIAA)

Aircraft Maintenance; Simulation

19980072167

The robotic air force

Tirpak, John A., USA; Air Force Magazine; Sep. 1997; ISSN 0730-6784; Volume 80, no. 9, pp. 70-74; In English; Copyright; Avail: Aeroplus Dispatch

The development of robotic military aircraft is examined. The use of such aircraft for attack as well as reconnaissance is addressed.
AIAA
Pilotless Aircraft; Military Aircraft

19980072293
Russia, Ukraine back An-70 transport
Fricker, John, USA; Aviation Week & Space Technology; Oct. 06, 1997; ISSN 0005-2175; Volume 147, no. 14, pp. 58-60; In English; Copyright; Avail: Aeroplus Dispatch

Design aspects of the An-70 transport aircraft are addressed. Expected performance data for the aircraft are given.
AIAA
Russian Federation; Ukraine; Antonov Aircraft; Transport Aircraft

19980072294
Navy eyes stealthy unmanned aircraft
Aviation Week & Space Technology; Oct. 13, 1997; ISSN 0005-2175; Volume 147, no. 15, pp. 27; In English; Copyright; Avail: Aeroplus Dispatch

Design for a stealthy, short-takeoff and vertical landing uninhabited combat air vehicles (UCAVs) being undertaken by the Navy are examined. These include a STOVL design for large, small, or new stealth aircraft carriers, a vertical attitude takeoff and landing (VATOL) design for small surface combat ships, and a submarine-launched VATOL concept.
AIAA
Pilotless Aircraft; Fighter Aircraft; Aircraft Performance

19980072296
Hyper-X production begins in support of 1999 flight test
Smith, Bruce A., USA; Aviation Week & Space Technology; Oct. 13, 1997; ISSN 0005-2175; Volume 147, no. 15, pp. 66, 67; In English; Copyright; Avail: Aeroplus Dispatch

Hyper-X is a NASA propulsion demonstration program intended to validate design tools which could be used in the future for development of hypersonic propulsion technology and air vehicles. Plans for the first flight test of the Hyper-X are described.
AIAA
Air Breathing Engines; Flight Tests; Flight Altitude; Aircraft Production; Technological Forecasting

19980072297
HSCT computer model takes shape at NASA
Ott, James, USA; Aviation Week & Space Technology; Oct. 13, 1997; ISSN 0005-2175; Volume 147, no. 15, pp. 68, 69; In English; Copyright; Avail: Aeroplus Dispatch

A preliminary technical configuration for the High Speed Civil Transport (HSCT) is discussed. The testing of this configuration, which is actually a computer-based model, is addressed.
AIAA
Computerized Simulation; Aircraft Models; NASA Programs; Aircraft Configurations

19980072304
LOCAAS sensor tests advance
Covault, Craig, USA; Aviation Week & Space Technology; Oct. 27, 1997; ISSN 0005-2175; Volume 147, no. 17, pp. 72, 73; In English; Copyright; Avail: Aeroplus Dispatch

The U.S. Air force and Army are preparing for a series of major new tests to demonstrate a more advanced laser radar sensor and other technologies involved with the new Low-Cost Autonomous Attack System (LOCAAS) air-launched smart munition. The vehicle and LADAR sensor are described. Special attention is given to planned glide tests of the sensor.
AIAA
Optical Radar

19980072590
On recovering an RPV with a net system in China
Zhang, Yi, Northwestern Polytechnical Univ., China; Zhang, Yuzuo, Northwestern Polytechnical Univ., China; Northwestern

Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 607-612; In Chinese; Copyright; Avail: Aeroplus Dispatch

A net recovery system has designed, constructed, and successfully operated in flight test. After detection with a ground automatic TV tracking system, two main functions of the guidance computer, i.e., the control of the locus of the RPV and its lateral and longitudinal control, are performed by two subsystems. A mathematical model was also designed. As a numerical example, we took a certain Chinese RPV. On the basis of its aerodynamic and flight data, we made simulation calculations. The results show preliminarily that our design is feasible. Later flight testing confirms that the net recovery system is feasible.

Author (AIAA)

Remotely Piloted Vehicles; Nets; Recovery

19980072853

Economic life determination for a military aircraft

Lincoln, John W., USAF, Aeronautical Systems Center, USA; Melliere, Ronald A., Boeing Co., USA; 1998, pp. 1899-1907; In English

Report No.(s): AIAA Paper 98-1828; Copyright; Avail: AIAA Dispatch

The USAF introduced the concept of economic life of an aircraft structure in the early seventies. They initially defined the economic life as the time when the structure had reached the point of widespread damage that is uneconomical to repair. The main difficulty with this definition is that the structural analysts cannot determine when the economic burden is unacceptable. They can, however, make a determination of the economic burden from inspections, replacements, and repair of the structure. The paper demonstrates this process for the F-15E. The structural analysts generated probability distributions from durability test cracking. They also derived usage severity variations from recorded data. For each airplane in the population, they sampled the distribution of the initial flaws, as well as the severity of the usage for each area of the airplane that would contribute to the maintenance cost. They grew these cracks to the point of a repair or modification action. The cost from repairs and modifications was one factor that USAF management used to determine if the airframe was still competitive with other alternatives.

Author (AIAA)

Military Aircraft; Economic Analysis; Service Life; Aircraft Structures

19980072883

Design and manufacture of Low-Cost Composite-Bonded Wing

Anderson, Timothy C., Bell Helicopter Textron, Inc., USA; Holzwarth, Richard C., USAF, Research Lab., USA; 1998, pp. 2199-2209; In English

Report No.(s): AIAA Paper 98-1870; Copyright; Avail: AIAA Dispatch

The Design and Manufacture of Low-Cost Composite Bonded Wing (DMLCC-BW) program is an R&D program is to reduce the recurring manufacturing costs of advanced composite structure by 50 percent relative to current methods and also reduce support costs by 25 percent. The objective is to introduce an improved stiffening alternative to that of the V-22 by using pultruded rods in the longitudinal stiffeners of the wing structure, and to improve the assembly time of a wing box by reducing part count using newer technologies, as well as to improve integration methods. The V-22 FSD wing provided the baseline for cost and strength comparisons. As such, the spar, rib locations, and basic wing profile would be held consistent with the V-22 FSD wing. In addition, the V-22 FSD loads were used for structural sizing. A base requirement of the design, imposed by the USAF, was that all baseline air vehicle requirements would be met.

Author (AIAA)

Aircraft Design; Composite Structures; Production Costs; Design to Cost; V-22 Aircraft

19980072885

The structural cost and weight reduction potential of more unitized aircraft structure

Holzwarth, Richard C., USAF, Research Lab., USA; 1998, pp. 2218-2227; In English

Report No.(s): AIAA Paper 98-1872; Copyright; Avail: AIAA Dispatch

The Advanced Lightweight Aircraft Structures (ALAFS) program was undertaken by the Joint Strike Fighter (JSF) Program to demonstrate the structural weight and life cycle cost reductions that could be achieved for fighter fuselage structure by implementing design concepts and manufacturing processes that enable the fabrication of more unitized structure. ALAFS was established to simulate the Engineering and Manufacturing Development phase of air vehicle design, but was limited in scope to structural risk reduction and demonstration. to accomplish this in a realistic environment, the ALAFS program intended to design, manufacture, and test a new concept center fuselage and mid-wing structure for the F/A-18E/F. The ALAFS program was terminated in November 1997 in order help resolve JSF program budget shortfalls. At the time of termination, the ALAFS program

had substantially completed the design for the ALAFS version of the F/A-18E/F mid wing and center fuselage. The cost and weight reductions due to this design indicate that there are significant payoffs for implementation of more unitized structure. There are some significant lessons learned for future air vehicle designs. These lessons are summarized.
Author (AIAA)
Aircraft Structures; Cost Reduction; Weight Reduction; Life Cycle Costs; Aircraft Design

19980072887
Composites affordability initiative - Phase I: concept design maturation
Baron, William, USAF, Research Lab., USA; Leger, Ken, USAF, Research Lab., USA; 1998, pp. 2239-2247; In English
Report No.(s): AIAA Paper 98-1874; Copyright; Avail: AIAA Dispatch

The best solution to exploit composite structures can only be achieved by modifying the design space, not through the substitution of composite for metal structure. This needs to be directed at changing load paths, modifying joining/assembly techniques, and looking at unique approaches for subsystem integration. These alternatives must be considered without adverse impact to system functionality in terms of operations and support. For this to occur a fully coordinated design approach needs to be undertaken that is baselined and defined from the system level. This will require composites to be considered as early in the conceptual design process as possible so that load paths are defined that offer manufacturability and do not penalize the efficiency of the composite structure. The properties of composite materials are directionally dependent and offer the ability to tailor the strength and stiffness of a structure in the directions which allow the most efficient management of airframe loads. Advancements in manufacturing using fiber placement, adhesive bonding, textile structures, and low cost tooling enable the designer to fully exploit the benefits of composite materials.
Author (AIAA)
Composite Structures; Aircraft Design; Production Costs; Cost Reduction; Composite Materials

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19980049048
Navier-Stokes analysis of subsonic flowfields over a missile configuration
Tuncer, Ismail H., U.S. Naval Postgraduate School, USA; Platzer, Max F., U.S. Naval Postgraduate School, USA; VanDyken, Robert D., U.S. Navy, Naval Air Warfare Center, USA; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 127-131; In English
Report No.(s): AIAA Paper 97-0635; Copyright; Avail: Aeroplus Dispatch

Subsonic flowfields over a missile configuration are computed at high angles of attack ranging from 15 to 60 deg with the NASA Ames Research Center OVERFLOW Navier-Stokes solver. The computed flowfields are presented in terms of particle traces, helicity contours, and surface streamlines. The flow separation over the missile body, the development of leeward-side vortex patterns, and the canard and tail vortices and their interaction are identified. The computed normal force and pitching moment coefficients compare well with the experimental data at an incidence of 15 deg. At higher incidences the normal force is underpredicted by up to 15 percent. The computed pitching moments agree qualitatively well with the experimental data, but percentage deviations are substantial in the higher incidence range.
Author (AIAA)
Navier-Stokes Equation; Subsonic Flow; Missile Configurations; Angle of Attack

19980049237
A 2D Navier-Stokes method for unsteady compressible flow calculations on moving meshes
Gaitonde, A. L., Bristol, Univ., UK; Jones, D. P., Bristol, Univ., UK; Fiddes, S. P., Bristol, Univ., UK; Aeronautical Journal; Feb. 1998; ISSN 0001-9240; Volume 102,, no. 1012, pp. 89-97; In English; Copyright; Avail: Aeroplus Dispatch

A moving mesh method for the computation of compressible viscous flow past deforming and moving airfoils is described. It is based on a well-established time-marching finite-volume scheme, which has been widely used for steady compressible flows. An implicit real-time discretization is used and the equations are integrated via a dual-time scheme. This involves the introduction of derivatives of a fictitious pseudo time. The solution at each real-time step involves seeking solutions which are steady-state solutions in pseudo time. This approach decouples the stability and accuracy limitations of the scheme and permits large real-time steps to be chosen. Well-proven convergence acceleration techniques developed for steady flows such as local-time stepping,

residual averaging, and multigrid may be used in the pseudo-time stepping scheme without compromising real-time accuracy. A sequence of body-conforming grids and corresponding grid speeds is required, where the inner and outer boundaries of the grid move independently. The required grids and speeds are found using a transfinite interpolation technique. Applications of the method to external compressible flows are shown, including results from a parallel version of the computer program.
Author (AIAA)
Two Dimensional Flow; Navier-Stokes Equation; Unsteady Aerodynamics; Compressible Flow; Computational Grids; Finite Volume Method

19980049298

Improved methodology for axial force prediction at angle of attack

Moore, F. G., U.S. Navy, Naval Surface Warfare Center, USA; Hymer, T. C., U.S. Navy, Naval Surface Warfare Center, USA; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 132-139; In English; Copyright; Avail: Aeroplus Dispatch

An improved semiempirical method for axial force calculation on missile configurations has been developed. The method uses the theoretical methods currently used in the U.S. Naval Surface Warfare Center's aeroprediction code for zero angle-of-attack axial force computations and several wind-tunnel databases to compute changes in axial force at angle of attack. The method is applicable to bodies alone, wing-body, and wing-body-tail configurations for both zero and nonzero control deflections. It has been developed to allow computation for angle of attack up to 90 deg at Mach numbers up to 20. However, it has been validated against data only to Mach number of 4.6. and angle of attack to 40 deg for all configurations. For body alone and wing-body cases, it has been validated to 90 deg angle of attack. Additional test data or Navier-Stokes computations would allow refinement of the improved method. The new method has been compared with several existing techniques. The method was found to be as good as or better than existing techniques, but more general than existing methods in terms of configurations and Mach numbers allowed for the method to be used.
Author (AIAA)
Methodology; Axial Loads; Angle of Attack; Missile Configurations

19980049299

Exploring the validity of the Spalart-Allmaras turbulence model for hypersonic flows

Paciorri, R., von Karman Inst. for Fluid Dynamics, Belgium; Dieudonne, W., von Karman Inst. for Fluid Dynamics, Belgium; Degrez, G., von Karman Inst. for Fluid Dynamics, Belgium; Charbonnier, J.-M., von Karman Inst. for Fluid Dynamics, Belgium; Deconinck, H., von Karman Inst. for Fluid Dynamics, Belgium; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 121-126; In English
Report No.(s): AIAA Paper 97-2023; Copyright; Avail: Aeroplus Dispatch

The Spalart-Allmaras turbulence model has been implemented in a finite volume code using an implicit finite difference technique. First, the implementation was validated on flat plate turbulent boundary-layer flows under various flow conditions. Then, three high-speed flow applications characterized by different turbulent phenomena were considered to investigate the behavior of the Spalart-Allmaras model in the hypersonic regime, namely, a hypersonic wind-tunnel flow, a Mach 5 flow over a hollow-cylinder flare, and a Mach 6.8 flow over a hyperboloid flare. Numerical results were found in excellent agreement with experimental data for the attached nozzle flow and the hyperboloid flow involving laminar separation and turbulent reattachment. For the hollow-cylinder flare configuration, which involves turbulent separation, the magnitudes of surface pressure and of heat transfer peaks were correctly predicted, whereas their positions were slightly incorrect due to the underprediction of the separation bubble size.
Author (AIAA)
Turbulence Models; Hypersonic Flow; Finite Volume Method; Finite Difference Theory; Flat Plates; Turbulent Boundary Layer

19980049336

Numerical predictions of hypersonic flow over a two-dimensional compression ramp

Amaratunga, S. R., Southampton, Univ., UK; Tutty, O. R., Southampton, Univ., UK; Roberts, G. T., Southampton, Univ., UK; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 230-232; In English
Report No.(s): AIAA Paper 96-4587; Copyright; Avail: Aeroplus Dispatch

Heat transfer rates are presented from laminar 2D numerical calculations of a Mach 6.85 ideal-gas flow past a hypersonic compression ramp. The numerical results are compared with experimental data obtained from a light-piston, isentropic-compres-

sion hypersonic wind tunnel. While the general flow features, which include a large separated-flow region, are correctly modeled, the separation and reattachment lengths are slightly overpredicted.
AIAA
Hypersonic Flow; Heat Transfer; Gas Flow; Ramps (Structures); Prediction Analysis Techniques; Two Dimensional Flow; Computational Fluid Dynamics; Aerodynamic Configurations

19980049501

Numerical simulation of an inviscid transonic flow through a channel with a leap

Lisewski, P., Warsaw Univ. of Technology, Poland; Archives of Mechanics - Archiwum Mechaniki Stosowanej; 1997; ISSN 0373-2029; Volume 49, no. 5, pp. 807-814; In English; Copyright; Avail: Aeroplus Dispatch

A two-dimensional inviscid transonic channel flow of a perfect gas is considered. The gas of relatively high pressure flows into a channel through a converging nozzle. The channel geometry is characterized by a discontinuity of cross-section at the nozzle outlet. A fast explicit differential algorithm based on a two-step Lax-Wendroff scheme is used to solve the set of Euler equations. Results of calculations are compared with the visualized flow and with the measured pressure distributions. The computed steady-state flow field agrees well with measurements.
Author (AIAA)
Transonic Flow; Flow Geometry; Inviscid Flow; Channel Flow; Euler Equations of Motion

19980049521

Airfoil design for sailplanes and ultralight aircraft

Reneaux, J., ONERA, France; Rodde, A. M., ONERA, France; Thibert, J. J., ONERA, France; ONERA, TP no. 1997-85; 1997; In English
Report No.(s): ONERA, TP no. 1997-85; Copyright; Avail: Aeroplus Dispatch

This paper presents the main results of ONERA’s involvement over the last 20 years in different studies related to sailplanes. An OAP airfoil family was designed to obtain a very high lift-to-drag ratio mainly in thermal flight. These were used to define the wings of Pegase and Marianne sailplanes produced by Societe Nouvelle Centrair. More recently, airfoils with flaps have been designed with thickness-to-chord ratio between 13 percent and 18 percent. Two airfoils devoted to ultralight aircraft and general aviation are also presented. For these applications, the paper describes the flow phenomena which have to be considered for the design (transition of the boundary layer, separation bubbles, stall behavior), the design process, and the performances of the different airfoils.
Author (AIAA)
Airfoil Profiles; Ultralight Aircraft; Gliders

19980049645

Comparison of experimental data for the coaxial-rotor and single-rotor flowfield in hovering

Tang, Zhengfei, Nanjing Univ. of Aeronautics and Astronautics, China; Gao, Zheng, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 627-632; In Chinese; Copyright; Avail: Aeroplus Dispatch

Based on the experimental data obtained from a 3-D laser Doppler velocimeter measuring the flow fields of a coaxial rotor and a single rotor in hover, their axial, radial, and circumferential velocities are compared, and their characteristics and differences are presented. It is pointed out that aerodynamic interactions between the coaxial rotors lead to a large difference between the flow field of a coaxial rotor and that of a single rotor. A further analysis of the extraordinary characteristics of the circumferential velocity is presented. It is important to construct a mathematical model of the coaxial-rotor flow field.
Author (AIAA)
Rotor Aerodynamics; Rotary Wings; Laser Doppler Velocimeters; Interactional Aerodynamics; Coaxial Flow

19980049648

Free wake calculation for helicopter rotor in forward flight

Xu, Guohua, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Shicun, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 648-653; In Chinese; Copyright; Avail: Aeroplus Dispatch

A full-span free wake model using the time stepping approach is established for predicting the distorted wake geometry of a helicopter rotor in forward flight. The model uses curved vortex elements on a circular arc as the basic discrete elements for trailing filaments and utilizes the free wake extension to form an adaptive far wake downstream. As examples, calculations on

the free wakes of UH-1 and H-34 rotors are performed for different advance ratios, and the features of highly distorted free wake shapes and a strong tendency toward a rapid wake roll-up for the low speed case are exhibited. By applying the free wake analysis, blade airloads are calculated, and the effect of wake distortion on blade airloads is discussed.
Author (AIAA)
Helicopter Wakes; Rotary Wings; Rotor Aerodynamics; Aerodynamic Loads; Rotor Blades

19980049656

Rigid-wake analysis of a coaxial rotor in hover aerodynamics

Wang, Ping, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Shicun, Nanjing Univ. of Aeronautics and Astronautics, China; Guo, Caigen, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 708-711; In Chinese; Copyright; Avail: Aeroplus Dispatch

The aerodynamic characteristics of coaxial rotors in hover state are investigated. A vortex cylinder model is given to represent a single Joukowski rotor, and two algebra formulas are found to approximate the first and second kinds of complete elliptical integrals. The whole vortex system of coaxial rotors is divided into a series of vortex cylinders. In addition, an experiment with the hovering aerodynamic characteristics of coaxial rotors was conducted on the rotor test stand.
Author (AIAA)
Rigid Rotor Helicopters; Helicopter Wakes; Rotor Aerodynamics; Aerodynamic Characteristics

19980049743

Computational simulation of emission spectra from shock-layer flows in an arcjet facility

Gokcen, Tahir, NASA Ames Research Center, USA; Park, Chung S., NASA Ames Research Center, USA; Newfield, Mark E., NASA Ames Research Center, USA; Fletcher, Douglas G., NASA Ames Research Center, USA; Journal of Thermophysics and Heat Transfer; Jun. 1998; ISSN 0887-8722; Volume 12, no. 2, pp. 180-189; In English
Contract(s)/Grant(s): NAS2-14031
Report No.(s): AIAA Paper 97-0135; Copyright; Avail: Aeroplus Dispatch

This paper reports computational comparisons with experimental studies of a nonequilibrium bluntbody shock-layer flow in a high-enthalpy arcjet wind tunnel at NASA/Ames. The experimental data include spatially resolved emission spectra of radiation emanating from a shock layer formed in front of a flat-faced cylinder model. Multitemperature nonequilibrium codes are used to compute the conical nozzle flow, supersonic jet, and shock-layer flow. A line-of-sight (LOS) radiation code is employed to predict the spectra from the computed flow field. Computed LOS emission intensities are directly compared with the experimental data at several axial locations along the stagnation streamline. Various LOS-averaged flow properties, such as vibrational and rotational temperatures, and species number densities, deduced from the experimental spectra, are compared with computed results. Comparisons provide an assessment of thermochemical equilibration processes in an arcjet shock layer.
Author (AIAA)
Computerized Simulation; Shock Layers; Emission Spectra; Nonequilibrium Flow; Arc Jet Engines; Blunt Bodies

19980049968

Unsteady propeller flows due to turbulence ingestion

Harden, J. M., Bristol, Univ., UK; Lowson, M. V., Bristol, Univ., UK; Aeronautical Journal; Feb. 1998; ISSN 0001-9240; Volume 102,, no. 1012, pp. 63-70; In English
Contract(s)/Grant(s): EPSRC-GR/J/15407; Copyright; Avail: Aeroplus Dispatch

A laser Doppler anemometer (LDA) was configured to provide simultaneous 1D velocity readings from two separate points in the contracting flow regime upstream of a 0.63 m diameter model propeller operating under high thrust conditions. Cross-correlations between the velocity signals were used to map the progress of turbulent eddy structures throughout the distortion, even within the highly oscillatory region close to the blades. These measurements were used to provide data on the strength and velocity of the eddies, as well as their average size and shape in two dimensions. The results show both elongation of the turbulent structures in the streamwise direction and distortion along their length, caused by the contracting flow and the high Reynolds stress. Linearized isotropic theory was used to predict the changes in the turbulent kinetic energies, and was found to be accurate for the longitudinal component only.
Author (AIAA)
Unsteady Aerodynamics; Propeller Blades; Cascade Flow; Laser Doppler Velocimeters; Turbulent Flow; Ingestion (Engines)

19980049975

Two-phase non-dissipative supersonic nozzle flow analysis for maximum condensed phase momentum flux

Lear, W. E., Florida, Univ., Gainesville, USA; Sherif, S. A., Florida, Univ., Gainesville; Acta Astronautica; May 1997; ISSN 0094-5765; Volume 40,, no. 10, pp. 707-712; In English; Copyright; Avail: Aeroplus Dispatch

The present optimization analysis has its basis in the maximization of the liquid water momentum flux for numerous mixture parameters encompassing liquid mass injection ratio, gas and liquid properties, nozzle size, and nozzle stagnation-to-back pressure ratios. The analysis is used to optimize a two-phase flow mixture consisting of a gaseous phase and an incompressible condensed phase through an industrial-cleaning converging/diverging nozzle.

AIAA

Two Phase Flow; Supersonic Nozzles; Supersonic Flow; Convergent-Divergent Nozzles; Momentum Transfer; Cleaning; High Pressure

19980050560

Application of a preconditioning method for aerodynamic problems

Saint Requier, C., Royal Inst. of Technology, Sweden; Duquesne, N., Royal Inst. of Technology, Sweden; 1998, pp. 45-50; In English; Copyright; Avail: Aeroplus Dispatch

The present paper investigates the use of the unsteady compressible Navier-Stokes equations to solve steady flow problems containing both incompressible and compressible zones. The difficulty in solving compressible Navier-Stokes equations for local low Mach numbers is associated with the large disparity between the acoustic wave speed and the convective wave speed: the system is stiff. by using a local preconditioning method, which sets all the wave speeds at the same order of magnitude, the stiffness can be removed. First numerical results obtained on a multi-element airfoil at Mach 0.185 indicate that local preconditioning can improve dramatically the convergence to a steady state solution. Comparisons between computed results with the preconditioning method and experimental results show a fairly good agreement.

Author (AIAA)

Unsteady Aerodynamics; Steady Flow; Preconditioning; Compressible Flow

19980050563

The influence of the downstream pressure on the shock wave reflection phenomenon in steady flows

Ben-Dor, G., Negev, Univ., Israel; Elperin, T., Negev, Univ., Israel; Li, H., Negev, Univ., Israel; Vasiliev, E., Volgograd State Univ., Russia; 1998, pp. 1-11; In English; Copyright; Avail: Aeroplus Dispatch

The effect of the downstream pressure on the shock wave reflection in steady flows is investigated both numerically and analytically. The dependence of the shock wave configurations on the downstream pressure is studied. In addition to the incident-shockwave-angle-induced hysteresis, which was discovered a few years ago, a new downstream-pressure-induced hysteresis has been found to exist. The numerical study reveals that, when the downstream-pressure is sufficiently high, an inverse-Mach reflection wave configuration, which has so far been observed only in unsteady flows, can be also established in steady flows. Very good agreement between the analytical predictions and the numerical results is evident.

Author (AIAA)

Pressure Effects; Steady Flow; Shock Wave Profiles; Mach Reflection

19980050673

Analogy-based method for solving compressible and incompressible flows

Darbandi, M., Waterloo, Univ., Canada; Schneider, G. E., Waterloo, Univ., Canada; Journal of Thermophysics and Heat Transfer; Jun. 1998; ISSN 0887-8722; Volume 12, no. 2, pp. 239-247; In English

Report No.(s): AIAA Paper 97-0706; Copyright; Avail: Aeroplus Dispatch

The different natures of compressible and incompressible governing equations of fluid flow generally classify the solution methods into two main categories of compressible and incompressible methods. This paper introduces an analogy that extends incompressible methods to solve compressible flows using the analogy of flow equations. In this analogy, the selected momentum component variables play a significant role in transferring the individual characteristics of the two formulations to a common basis. to develop the methodology, a control-volume-based finite element approach is used to solve the governing differential equations for a collocated grid distribution. The definition of two types of mass flux components at the surfaces of the control volume removes the possibility of velocity-pressure decoupling in the Euler limit. The analogy-based method is demonstrated

by testing a number of selected cases. A highly recirculating problem, the entrance flow, and the nozzle flow are among those for which results are presented. These results demonstrate excellent performance of the analogy and the resulting methodology.
Author (AIAA)
Compressible Flow; Incompressible Flow; Fluid Flow; Analogies; Flow Equations; Computational Fluid Dynamics

19980050903

Numerical study of unsteady flow around airfoil with spoiler

Xu, Cheng, Singapore Productivity and Standard Board, Singapore; Yeung, W. W. H., Nanyang Technological Univ., Singapore; Journal of Applied Mechanics; Mar. 1998; ISSN 0021-8936; Volume 65, no. 1, pp. 164-170; In English; Copyright; Avail: Aeroplus Dispatch

A discrete vortex model based on the panel method has been developed to simulate the 2D unsteady separated flow generated by the rapid deployment of a spoiler on the upper surface of an airfoil. This method represents the boundary surfaces by distributing piecewise linear-vortex and constant source singularities on discrete panels. The wake of the spoiler and airfoil is represented by discrete vortices. At each sharp edge, a vortex sheet is used to feed discrete vortices at every timestep to form the downstream wake. The length and strength of each shed vortex sheet are determined by the continuity equation and a condition such that the flow, the net force, and the pressure difference across the vortex sheet are zero. The flow patterns behind the spoiler at different time-steps are presented. The pressure distributions on the airfoil based on the unsteady Bernoulli's equation are compared, where possible, with the experimental results and other computational results. The adverse lift effects are obtained, and similar effects are measured in experiments.
Author (AIAA)
Unsteady Flow; Airfoils; Spoilers

19980051090

Application of the VLM to the propulsive performance of a pair of oscillating wing-tails

Belibassakis, K. A., Athens, National Technical Univ., Greece; Politis, G. K., Athens, National Technical Univ., Greece; Triantafyllou, M. S., MIT, USA; 1997, pp. 449-458; In English; Copyright; Avail: Aeroplus Dispatch

A 3D unsteady vortex lattice technique is applied to the analysis of a pair of vertical oscillating wing tails in order to investigate quantitatively its propulsive performance. Each lifting component undergoes a combined transverse and angular motion at the same frequency in a uniform inflow condition. A free-wake analysis is incorporated in order to account for the effects of nonlinearity, especially at increased amplitudes of oscillatory motion. Numerical results are presented vs experimental measurements for the propulsion thrust coefficient and the efficiency of the system over a range of motion parameters, including wing aspect ratio, Strouhal number, feathering parameter, and phase lag between oscillatory motions. These results indicate the significance of 3D effects and show that the present technique, after appropriate elaboration, especially as concerns unsteady LE flow separation and stall effects, can facilitate the design of this kind of propulsive system with optimized performance.
Author (AIAA)
Vortex Lattice Method; Propulsion System Performance; Body-Wing and Tail Configurations

19980051667

Effect of surface temperature on the stability of a supersonic boundary layer at the attachment line of a swept wing ***Vliyanie temperatury poverkhnosti na ustojchivost' sverkhzvukovogo pogranichnogo sloya na linii rastekaniya skol'zyashchego kryla***

Kazakov, A. V., Russian Federation; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Oct. 1997; ISSN 0568-5281, no. 5, pp. 43-49; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of calculations of flow stability at the attachment line of a swept wing are presented for subsonic and supersonic velocities. Neutral curves for different Mach numbers of the incoming flow and different surface temperatures are presented for a 60-deg swept wing. It is shown that an increase in the Mach number produces a second instability region with characteristic wavenumber values of 3-10. Surface heating stabilizes perturbations in the main instability region with wavenumbers of 3-10, whereas surface cooling may have the opposite effect.
AIAA
Surface Temperature; Temperature Effects; Boundary Layer Stability; Supersonic Boundary Layers; Swept Wings

19980052915

Experimental investigation of natural disturbances in a hypersonic boundary layer on a flat plate

Maslov, A. A., Russian Acad. of Sciences, Russia; Sidorenko, A. A.; Shiplyuk, A. N.; Journal of Applied Mechanics and Technical Physics (English translation of PMTF, Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki); Jul, 1997; ISSN 0021-8944; Volume 38, no. 1, pp. 64-68; In English; Copyright; Avail: Issuing Activity

The characteristics of natural disturbances are studied experimentally at Mach numbers M(sub infinity) = 6 in a laminar boundary layer on a heat-insulated plate with a sharp leading edge. The model was a flat steel plate 10 mm thick. Its planform was a trapezoid 250 mm long with bases of 140 and 110 mm. The sweep angle of the model edges was 14 deg 30'. The radius of the edge bluntness was less than 0.05 mm. The model was placed horizontally at zero angle of attack in the central plane of the test section of the wind tunnel. Experimental results on the stability of natural disturbances in the boundary layer of the flat plate are presented.

EI

Flat Plates; Hypersonic Boundary Layer; Mach Number; Hypersonics; Boundary Layers; Wind Tunnels; Reynolds Number; Plates (Structural Members)

19980053179 Air Force Inst. of Tech., Graduate School of Engineering, Wright-Patterson AFB, OH USA

Flow Field and Loading Analysis on a Wrap-Around Fin Missile

McIntyre, Thomas C., Air Force Inst. of Tech., USA; Dec. 1997; 115p; In English

Report No.(s): AD-A336653; AFIT/GAE/ENY/97D-04; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Wrap-around fin (WAF) missiles offer packaging benefits but experience rolling moments due to the curved fin design. Rolling moments stabilize unguided projectiles, but cause guidance and control problems for future guided applications. Understanding the flow field in the vicinity of the fins is critical to future missiles. Fin pressure profiles were characterized with pressure-sensitive paint. Two rectangular four-fin constructions were tested - one solid and one with a rectangular hole (slotted fin). Static pressure data were divided by free-stream total pressure for presentation. Tests were conducted at Mach numbers of 2.15, 2.28, 2.41, 2.86, 3.25, 3.50 and 3.83. Reynolds numbers based on missile diameter ranged from 4.0 x 10(exp 6) to 1.3 x 10(exp 7). Mach 2.86 pressure profiles on the solid fin were compared to computational fluid dynamic (CFD) predictions on a single wall-mounted fin. The four-fin model pressure distributions agreed with CFD, verifying that a single wall-mounted fin captures relevant WAF aerodynamics. Slotted fin pressure profiles were similar to solid fin profiles, except in the vicinity of the slot.

DTIC

Flow Distribution; Mach Number; Reynolds Number; Pressure Distribution; Wind Tunnel Tests; Missile Configurations; Rolling Moments

19980053857

Application of the Newton method to the calculation of internal supersonic separated flows

Bashkin, V. A., Central Aerohydrodynamic Inst., Russia; Yegorov, I. V.; Ivanov, D. V.; Journal of Applied Mechanics and Technical Physics (English translation of PMTF, Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki); Jul, 1997; ISSN 0021-8944; Volume 38, no. 1, pp. 26-37; In English; Copyright; Avail: Issuing Activity

The method for numerical integration of the two-dimensional Navier-Stokes and Euler equations is extended to the solution of problems of internal aerodynamics. A technique for generating a refined computation grid in boundary-layer regions depending on the Reynolds number is developed. Calculations of the supersonic flow of a perfect gas in a flat duct of variable cross section are performed. The effect of the Reynolds number on the structure of the flow field and heat exchange is shown.

EI

Differential Equations; Internal Flow; Newton Methods; Separated Flow; Supersonic Flow; Supersonics; Reynolds Number; Navier-Stokes Equation; Measure and Integration

19980053858

Spatial supersonic flows at TSTO separation of aerospace systems

Bonnefond, T., AEROSPATIALE, France; Adamov, N. P.; Brodetskii, M. D.; Vasenev, L. G.; Derunov, E. K.; Kharitonov, A. M.; Journal of Applied Mechanics and Technical Physics (English translation of PMTF, Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki); Jul, 1997; ISSN 0021-8944; Volume 38, no. 1, pp. 18-25; In English; Copyright; Avail: Issuing Activity

Schematized models of the first and second stages are used to test models of the most promising TSTO concepts of two-stage vehicles. In such a setting, the experimental data obtained meet the requirements of tests of the models developed and of the numerical simulation methods for typical features of flow past stages under their separation. A detailed study of distributed characteristics in combination with visualization of the interfering shocks provides a more profound understanding of the conditions of

formation of the interference components of aerodynamic forces and moments and can be successfully used for the development of approximate methods for estimating the interference components.
EI
Aerospace Systems; Supersonic Flow; Supersonics; Space Shuttles; Computerized Simulation; Mathematical Models

19980053984
Experimental study of generation of unstable disturbances on the leading edge of a plate at M = 2
Kosinov, A. D., Russian Acad. of Sciences, Russia; Maslov, A. A.; Semionov, N. V.; Journal of Applied Mechanics and Technical Physics (English translation of PMTF, Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki); Jul, 1997; ISSN 0021-8944; Volume 38, no. 1, pp. 45-51; In English; Copyright; Avail: Issuing Activity

Unstable disturbances in the supersonic boundary layer are generated on the leading edge of a plate by external controlled disturbances. The wave spectra of initial disturbances and the boundary-layer disturbances generated by them are determined. The experiments were carried out in the T-325 supersonic wind tunnel with a 200 x 200 x 600 mm test section at a Mach number M = 2 and a unit Reynolds number Re(sub 1) = 6.6 x 10(sup 6) 1/m.
EI
Leading Edges; Mach Number; Supersonic Flow; Boundary Layer Flow; Wind Tunnels; Reynolds Number; Mathematical Models

19980054200
Exact solution of the plane elasticity problems for the non-symmetric airfoil crack
Shirokova, E. A., Kazan Univ., Russia; Salahudinov, R. G.; Mechanics Research Communications; Mar-Apr, 1997; ISSN 0093-6413; Volume 24, no. 2, pp. 131-136; In English; Copyright; Avail: Issuing Activity

The first and second basic problems are solved simultaneously by the method used for the symmetric airfoil crack. The form of the crack depends on some parameters and its exterior is the image of the unit disk exterior under the mapping by the function. The solution is applied to the problem of two-dimensional Stokes flow of viscous fluid about the airfoil.
EI
Elastic Properties; Stokes Flow; Fracture Mechanics; Numerical Analysis; Cracks; Airfoils

19980054389
Aerodynamics of a covered pedestrian bridge of a trapezoidal section
Zdravkovich, M. M., Univ. of Salford, UK; Carelas, E.; Journal of Wind Engineering and Industrial Aerodynamics; Feb, 1997; ISSN 0167-6105; Volume 66, no. 2, pp. 141-153; In English; Copyright; Avail: Issuing Activity

Neighbouring offshore platforms are often connected by bridges, which are exposed to high wind forces. Many of these bridges are trapezoidal in section, a shape which has not attracted sufficient research in the past. An experimental programme investigated the pressure distribution from which lift and drag forces are evaluated. The effect of free-stream turbulence, roundness of the edges, and Reynolds number are examined. Finally, an aeroelastic model was built and the dynamic response was investigated in the range of reduced velocities from 2.5 to 8.7. The maximum amplitude of oscillation occurred at the highest reduced velocity tested.
Author (EI)
Pressure Distribution; Aerodynamics; Bridges (Structures); Pressure Effects; Drag

19980055123 NASA Dryden Flight Research Center, Edwards, CA USA
Development of the X-33 Aerodynamic Uncertainty Model
Cobleigh, Brent R., NASA Dryden Flight Research Center, USA; Apr. 1998; 36p; In English
Contract(s)/Grant(s): RTOP 242-33-02-00-23
Report No.(s): NASA/TP-1998-206544; NAS 1.60:206544; H-2221; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An aerodynamic uncertainty model for the X-33 single-stage-to-orbit demonstrator aircraft has been developed at NASA Dryden Flight Research Center. The model is based on comparisons of historical flight test estimates to preflight wind-tunnel and analysis code predictions of vehicle aerodynamics documented during six lifting-body aircraft and the Space Shuttle Orbiter flight programs. The lifting-body and Orbiter data were used to define an appropriate uncertainty magnitude in the subsonic and supersonic flight regions, and the Orbiter data were used to extend the database to hypersonic Mach numbers. The uncertainty data consist of increments or percentage variations in the important aerodynamic coefficients and derivatives as a function of Mach number along a nominal trajectory. The uncertainty models will be used to perform linear analysis of the X-33 flight control system

and Monte Carlo mission simulation studies. Because the X-33 aerodynamic uncertainty model was developed exclusively using historical data rather than X-33 specific characteristics, the model may be useful for other lifting-body studies.
Author
Aerodynamic Characteristics; X-33 Reusable Launch Vehicle; Monte Carlo Method; Lifting Bodies; Hypersonics; Flight Control; Space Shuttle Orbiters

19980055234

Numerical fluid flow analysis for aerodynamic characteristics of rectangular section

Watanabe, W., Tokyo, Univ., Japan; Maruoka, A., Tokyo, Univ., Japan; Hirano, H., Chuo Univ., Japan; Kawahara, M., Chuo Univ., Japan; 1998, pp. 82-87; In English; Copyright; Avail: Aeroplus Dispatch

Three-dimensional analysis of the unsteady flows around a rectangular cylinder is carried out by means of IBTD+FS finite element technique without any turbulence model. In case of the 3D analysis, it is confirmed that the aerodynamic characteristics of a rectangular cylinder with a side ratios of depth/breadth (B/D) of 4.0 is good agreement with the experimental result. The simulation of the detailed behaviors of the reattachment flow and the vortex motions around a rectangular cylinder is succeeded. The relation between the cylinder and the aerodynamic is also investigated.
Author (AIAA)
Incompressible Flow; Aerodynamic Characteristics; Finite Element Method; Vortices; Pressure Distribution; Wind Tunnel Tests

19980055236

A comparison of unstructured finite volume schemes for high speed flow simulations

Korzenowski, Heidi, Inst. Tecnologico de Aeronautica, Brazil; Azevedo, Joao L. F., Inst. de Aeronautica e Espaco, Brazil; 1998, pp. 100-105; In English; Copyright; Avail: Aeroplus Dispatch

A comparison of five different spatial discretizations schemes is described for the solution of compressible flows using unstructured grid finite volume techniques. The algorithms studied include a central difference-type scheme, and first- and second-order van Leer and Liou flux-vector splitting schemes. These methods are implemented in an efficient, edge-based, unstructured grid procedure which allows for adaptive mesh refined based on flow property gradients. The test case considered is the flow in a high-speed inlet which is representative of some proposed configurations for transatmospheric vehicles. Flow fields are simulated using the 2D Euler equations, discretized in a cell centered finite volume procedure. Results for different entrance Mach numbers are discussed in order to assess the comparative performance of the various spatial discretization schemes.
Author (AIAA)
Hypersonic Flow; Finite Volume Method; Compressible Flow; Spatial Distribution; Runge-Kutta Method

19980055260

Shock capturing viscosities for the general algorithm

Nithiarasu, P., Univ. of Wales, UK; Zienkiewicz, O. C., Univ. of Wales, UK; Satyasai, B. V. K., Univ. of Wales, UK; Morgan, K., Univ. of Wales, UK; Codina, R., International Center for Numerical Methods in Engineering, Spain; Vazquez, M., International Center for Numerical Methods in Engineering, Spain; 1998, pp. 350-356; In English
Contract(s)/Grant(s): NAGW-2127; Copyright; Avail: Aeroplus Dispatch

The performance of shock capturing viscosities for the general fluid mechanics algorithm is discussed. Four different procedures - inviscid flow past a cylinder at M = 2, supersonic laminar viscous flow past a flat plate, hypersonic flow past a cylinder, and flow over a cylinder at M = 3.0 - are examined and compared with existing results.
AIAA
Hypersonic Flow; Inviscid Flow; Fluid Mechanics; Shock Discontinuity; Viscous Flow; Supersonic Flow

19980055271

Three dimensional simulations of the flow in a slotted transonic wind tunnel

Vieira, Renato, Sao Paulo, Univ. Estadual, Brazil; Azevedo, Joao L. F., Inst. de Aeronautica e Espaco, Brazil; Fico, Nide G. C. R., Jr., Inst. Tecnologico de Aeronautica, Brazil; Basso, Edson, Inst. Tecnologico de Aeronautica, Brazil; 1998, pp. 431-436; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents flow simulations relevant to transonic wind tunnel design and operation. A 3D, finite difference, computational code which solves the Euler equations in a general, body-conforming, curvilinear grid has been developed and used for these simulations. This code incorporates the capability of including test section wall slots for realistic simulation of a transonic wind tunnel facility. Test cases considered include a tunnel contraction alone and a complete high-speed tunnel segment. Both cases with closed and open slots were considered. The results obtained adequately reproduced the expected flow features for the condi-

tions analyzed and indicated that the particular configuration studied holds promise of providing very good test section flow quality.
Author (AIAA)
Transonic Wind Tunnels; Three Dimensional Models; Slotted Wind Tunnels; Finite Difference Theory; Flow Characteristics

19980055278
Adaptive refinement and overset structured grids
Meakin, Robert L., U.S. Army, USA; 1998, pp. 507-512; In English; Copyright; Avail: Aeroplus Dispatch

The need for adaptive refinement for unsteady aerodynamic applications that may involve relative motion between configuration component parts is recognized. Computational advantages of structured data are reviewed. Properties of uniform Cartesian (structured) grids that lead to substantial computational advantages are identified. A method of adaptive spatial partitioning and refinement is used to simulate viscous flow about 3D test configurations of practical significance.
Author (AIAA)
X-38 Crew Return Vehicle; Helicopter Control; Unsteady Aerodynamics; Aerodynamic Configurations

19980055281
Finite element methods for 3D transient flows involving moving boundaries
Hassan, O., Univ. of Wales, UK; Bayne, L. B., Univ. of Wales, UK; Morgan, K., Univ. of Wales, UK; Probert, E. J., Univ. of Wales, UK; Weatherill, N. P., Univ. of Wales, UK; 1998, pp. 525-530; In English
Contract(s)/Grant(s): EPSRC-GR/K/42264; Copyright; Avail: Aeroplus Dispatch

A numerical procedure for simulating 3D transient compressible inviscid flows, with moving boundary components, is described. The approach followed is a finite element implementation on an unstructured tetrahedral grid. The boundary movement is handled by incorporating an adaptive mesh strategy. Computational efficiency is enhanced by parallelization. Examples are included which demonstrate the numerical performance that may be achieved.
Author (AIAA)
Wing Oscillations; Finite Element Method; Unsteady Aerodynamics; Oscillating Flow

19980055289
Applications of unstructured grid method to high-Reynolds number viscous flows
Nakahashi, Kazuhiro, Tohoku Univ., Japan; Sharov, Dmitri, Fujitsu, Ltd., Japan; 1998, pp. 580-585; In English; Copyright; Avail: Aeroplus Dispatch

An unstructured grid method to compute 3D compressible viscous flows of complex geometry is discussed. A hybrid of prismatic and tetrahedral grids is used to accurately resolve the wall boundary layers for high Reynolds number viscous flows. The Navier-Stokes equations for compressible flows are solved by a finite-volume, cell-vertex scheme. The LU-SGS implicit time integration method is used to reduce the computational time for very fine grid in boundary layer regions. Two kinds of one-equation turbulence models are evaluated here for their accuracy. Computations of transonic flows around airplanes and hypersonic flows inside a scramjet inlet demonstrate the capability of the method.
Author (AIAA)
Viscous Flow; Computational Grids; Compressible Flow; Finite Volume Method; Aircraft Configurations; Hypersonic Flow

19980055292
Coupled fluid-structure instabilities at high flight speeds
Sarigul-Klijn, Nesrin, California, Univ., Davis, USA; Capece, Vincent R., California, Univ., Davis; 1998, pp. 598-603; In English; Copyright; Avail: Aeroplus Dispatch

This paper addresses aeroelastic instabilities of advanced flight vehicles at subsonic, supersonic, and hypersonic velocities. Finite element and Rayleigh-Ritz formulations together with small disturbance unsteady aerodynamic theory are used for predictions of fluid-structure interaction instabilities of advanced composite lifting surfaces. The fluid-structure interactions are dealt with using meshless methods. The effects of aspect ratio, chordwise vibration modes, and thermal conditions on the fluid-structure stability boundary are studied. Numerical results are presented for a balanced composite lifting surface of (+/- theta/0)s stacking sequence to demonstrate the influence of chordwise modes on flutter and divergence predictions. The lifting surfaces studied have aspect ratios ranging from 1 to 12. The study illustrates that, by addition of the chordwise vibration modes, the frequencies of the

low-aspect ratio lifting surfaces may not only be influenced in accuracy, but also the chordwise mode itself may become the flutter mode, depending on the ply orientation.
Author (AIAA)
Flight Vehicles; Fluid-Solid Interactions; Unsteady Aerodynamics; Lifting Bodies; Vibration Mode

19980055293

A discontinuous Galerkin method for the compressible Navier-Stokes equations on hybrid grids

Warburton, T. C., Brown Univ., USA; Lomtev, I., Brown Univ., USA; Kirby, R. M., Brown Univ., USA; Karniadakis, G. E., Brown Univ., USA; 1998, pp. 604-609; In English; Copyright; Avail: Aeroplus Dispatch

We present a discontinuous Galerkin matrix-free formulation for the compressible Navier-Stokes equations based on spectral/hp hybrid element discretization. We first review the formulation and subsequently present convergence results for a Euler flow, and simulation results for viscous supersonic flow past a NACA4420 airfoil at an angle of attack, and for viscous subsonic flow past a multi-element airfoil.
Author (AIAA)
Compressible Flow; Galerkin Method; Viscous Flow; Supersonic Flow

19980055294

The parallel computation of turbulent flow about a complete aircraft

Manzari, M. T., Univ. of Wales, UK; Hassan, O., Univ. of Wales, UK; Morgan, K., Univ. of Wales, UK; Weatherill, N. P., Univ. of Wales, UK; 1998, pp. 610-615; In English
Contract(s)/Grant(s): EPSRC-GR/K/42264; Copyright; Avail: Aeroplus Dispatch

A numerical procedure is presented for simulating 3D turbulent flow problems. The mass-averaged Navier-Stokes equations are solved together with the low-Reynolds kappa-omega two-equation turbulence model. The standard Galerkin approach is used for spatial discretization. Stabilization and discontinuity capturing is achieved by the addition of an appropriate diffusion. An explicit multistage time-stepping scheme is used to advance the solution in time to steady state. The study of realistic problems involving complex geometries can be achieved by using parallel computers. The results of a simulation involving transonic turbulent flow about a complete aircraft are presented.
Author (AIAA)
Turbulent Flow; Aircraft Configurations; Parallel Computers; Galerkin Method; Transonic Flow; Flow Stability

19980055364

Vortex dynamics of blade-blade interaction

Yao, Z. X., Arizona State Univ., Tempe, USA; Liu, D. D., Arizona State Univ., Tempe; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 497-504; In English
Report No.(s): AIAA Paper 94-0737; Copyright; Avail: Aeroplus Dispatch

A time domain method has been developed for treatments of vortex dynamics in all classes of blade-blade interaction problems. A new vortex impingement condition is introduced to the discrete vortex tracking scheme and was found most effective in handling the vortex-airfoil interaction and the blade-blade interaction (BBI) problems. Present results are verified with all classical solutions and are found in good agreement with almost all existing solutions. The present BBI study concludes that any front blade movement will induce a strong interaction between the wake and the rear blade; hence, it alters drastically the lift response and the wake structure. Any rear blade movement only induces a weak interaction, rendering the blade system ineffective.
Author (AIAA)
Vortices; Interactional Aerodynamics; Airfoils; Blade-Vortex Interaction

19980055368

Coupled vibration-dissociation-exchange reactions model for hypersonic airflow computations

Seror, S., Aix-Marseille I, Univ., France; Druguet, M.-C., Aix-Marseille I, Univ., France; Schall, E., Aix-Marseille I, Univ., France; Zeitoun, D. E., Aix-Marseille I, Univ., France; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 532-538; In English
Report No.(s): AIAA Paper 97-2556; Copyright; Avail: Aeroplus Dispatch

A preferential coupled vibration-dissociation and exchange reactions-vibration model resulting from an extension of the well-known Treanor and Marrone coupled vibration-dissociation-vibration model has been derived to take into account the coupling between the vibrational excitation of the N2 and O2 molecules and the two Zeldovich exchange reactions. Analytical expressions for the exchange reactions coupling factor and for the average vibrational energy lost - or gained - by a molecule through

an exchange reaction have been developed. The influence of such a coupling has been shown by means of numerical simulations of hypersonic airflows through different configurations: normal and bow shock waves, wind-tunnel nozzle, and boundary layer. Code-to-code comparisons of our model and other recent approaches and code-to-experiments comparisons have been conducted for the one-dimensional flow behind a normal shock wave. These comparisons have shown good agreement of our model results with the experimental data.
Author (AIAA)
Hypersonic Flow; Air Flow; Gas Dissociation; Molecular Oscillations; Nitrogen; Oxygen

19980055370
Effects of periodic excitation on turbulent flow separation from a flap
Nishri, B., Tel Aviv Univ., Israel; Wygnanski, I., Tel Aviv Univ., Israel; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 547-556; In English; Copyright; Avail: Aeroplus Dispatch

The effects of periodic perturbations on delaying separation or promoting reattachment of initially separated flow were experimentally investigated. The leading parameters affecting the flow are the flap deflection, the input momentum, and its reduced frequency. The sensitivity of the flow to the imposed oscillations depends on its initial state, and this leads to hysteresis with respect to changes in any of the aforementioned parameters. For example, the most effective frequency required to attach the flow to the surface is much lower than the one required to prevent its separation. The amplitude needed to force reattachment may be an order of magnitude larger than the amplitude required to prevent separation at a given inclination of the flap. Nevertheless, periodic forcing is much more effective than steady blowing for boundary-layer control.
Author (AIAA)
Excitation; Turbulent Flow; Separated Flow; Reattached Flow; Flaps (Control Surfaces); Active Control

19980055371
Measurement of three-dimensional crossflow separation
Wetzel, Todd G., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Simpson, Roger L., Virginia Polytechnic Inst. and State Univ., Blacksburg; Chesnakas, Christopher J., Virginia Polytechnic Inst. and State Univ., Blacksburg; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 557-564; In English
Contract(s)/Grant(s): N00014-91-J-1732; N00014-95-1-0101; N00014-94-1-0092; Copyright; Avail: Aeroplus Dispatch

Parameters and techniques for detecting the location of three-dimensional crossflow separations are evaluated using several data sets. Several definitions of separations and the physics of the separation process are discussed along with descriptions of the separated flowfield. Measurement techniques that depend on each of these descriptions are then considered, and data are compared and contrasted. The data analyzed here represent a very rare combination of many different measurement techniques applied to the same geometry and apparatus from several different studies, including oil flow visualization, laser Doppler velocimetry, surface pressure, and surface hot-film skin-friction measurements (magnitude only and directional). Pressure is the least sensitive of the indicators of separation, although minima in rms pressure fluctuations correlate well with separation location. Hot-film skin-friction magnitude measurement is one of the easiest and most accurate techniques; local minima correlate well with separation location. Laser Doppler velocimeter measurements provide the most detail about the separation flowfield but at great expense and with the limitation of requiring knowledge of the separation line direction. Directional surface hot-film measurements provide data that, when integrated, yield a global measurement of separation and detailed surface topology. The issues discussed in this work are also relevant when interrogating computational fluid dynamics data sets for separation phenomena.
Author (AIAA)
Three Dimensional Flow; Cross Flow; Separated Flow; Three Dimensional Boundary Layer; Skin Friction

19980055372
Experimental study of an unsteady separating boundary layer
Lurie, E. A., MIT, USA; Keenan, D. P., MIT, USA; Kerwin, J. E., MIT, USA; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 565-570; In English
Contract(s)/Grant(s): N00014-89-J-3194; N00014-93-1-1043; Copyright; Avail: Aeroplus Dispatch

The objective of this research is to map the flowfield around the trailing edge of a hydrofoil subject to transverse gust loading, to provide guidance for the formulation of an appropriate Kurta condition for inviscid solution methods. The hydrofoil is equipped with a trailing edge that incurs boundary-layer separation over the last few percent of the chord. Mean and unsteady velocity profiles are presented for the Reynolds number of 3.8 x 10 exp 6 and reduced frequency of 3.6. The location of the separation point

in steady flow is identified, and the region of the separation trajectory in unsteady flow is seen. The magnitude and phase of the unsteady circulation and lift are found and compared to those values predicted by linearized methods.
Author (AIAA)
Unsteady Flow; Boundary Layer Separation; Hydrofoils; Gust Loads; Trailing Edges; Flow Distribution

19980055373

Supersonic breakaway separation past an adiabatic wavy wall

Rothmayer, Alric P., Iowa State Univ., Ames, USA; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 571-577; In English
Contract(s)/Grant(s): F49620-95-1-0275; Copyright; Avail: Aeroplus Dispatch

Triple-deck free interactions for breakaway separation are computed for flow past an adiabatic wavy wall. These solutions depend on a phase shift, which positions the breakaway separation relative to the wavy wall. It is found that the downstream shear layer slope of the breakaway separation is largely unaffected by the wavy wall.
Author (AIAA)
Supersonic Boundary Layers; Boundary Layer Separation; Adiabatic Conditions; Phase Shift; Boundary Layer Equations; Wall Flow

19980055374

Numerical study of supersonic direct current plasma nozzle flow

Jodoin, Bertrand, Sherbrooke, Univ., Canada; Proulx, Pierre, Sherbrooke, Univ., Canada; Mercadier, Yves, Sherbrooke, Univ., Canada; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 578-584; In English; Copyright; Avail: Aeroplus Dispatch

To address the problem of studying the complex flow in dc supersonic plasma torches, an axisymmetric two-dimensional numerical code is developed. The aerodynamic fields are assumed to be expressed by a set of modified Euler equations in which heat conduction, generation, and radiative losses are included. A one-dimensional model is used for the nonequilibrium cathode sheath. The results for a 30 kW argon-hydrogen plasma are in good agreement with published experimental work. The theoretical results show that the structure of the flow can be divided radially in three distinct zones with specific transfer mechanisms, clarifying fundamental questions on this subject. The model results show a significant improvement over simple engineering design methods for supersonic plasma jet nozzles.
Author (AIAA)
Supersonic Flow; Nozzle Flow; Magnetohydrodynamic Flow; Direct Current; Two Dimensional Flow; Jet Nozzles

19980055375

Vortex breakdown on a pitching delta wing - Control by intermittent trailing-edge blowing

Vorobieff, Peter V., Los Alamos National Lab., USA; Rockwell, Donald O., Lehigh Univ., USA; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 585-589; In English; Copyright; Avail: Aeroplus Dispatch

To retard the onset of vortex breakdown on a half-delta wing subjected to periodic, large-amplitude maneuvers to high angle of attack, controls were applied in the form of a deflectable flap at the leading edge and variable blowing at the trailing edge of the wing. Intermittent blowing, applied during the upstroke part of the pitching cycle, appears to be the most energetically efficient means of retarding the onset of breakdown. Corresponding values of a dimensionless blowing coefficient are an order of magnitude smaller than those traditionally employed. Particle image velocimetry measurements of the velocity field in the plane of the leading-edge vortex show that blowing-induced changes of the velocity field propagate upstream along the lower surface of the wing. Intermittent blowing produces a radical change in the velocity distribution near the surface of the delta wing that persists throughout the entire pitching cycle. The phase lag of the blowing-induced velocity appears to be central to maintaining retardation of the onset of breakdown.
Author (AIAA)
Vortex Breakdown; Delta Wings; Pitching Moments; Trailing Edges; Blowing

19980055378

Fast Newton-Krylov method for unstructured grids

Blanco, Max, Toronto, Univ., Canada; Zingg, David W., Toronto, Univ., Canada; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 607-612; In English
Report No.(s): AIAA Paper 97-0331; Copyright; Avail: Aeroplus Dispatch

Three algorithms are presented and compared for the solution of the steady Euler equations on unstructured triangular grids. All are variations on Newton's method, one quasi- and two full-Newton schemes, and employ the BILU (n)-preconditioned generalized minimum residual method (GMRES) algorithm to solve the Jacobian matrix problem that arises at each iteration. The quasi-Newton scheme uses a first-order approximation to the Jacobian matrix with the standard GMRES implementation, in which matrix-vector products are formed in the usual explicit manner. The full-Newton schemes are distinguished by the implementation of GMRES: One employs the standard GMRES algorithm, and the other is matrix free using Frechet derivatives. The matrix-free, full-Newton algorithm is shown to be the fastest of the three algorithms. Optimal preconditioning, reordering, and storage strategies for the matrix-free, full-Newton algorithm are presented. Register and cache performance issues are briefly discussed.
Author (AIAA)
Computational Grids; Jacobi Matrix Method; Euler Equations of Motion; Compressible Flow; Inviscid Flow; Transonic Flow

19980055386

Turbulence structure in the spiral wake shed by a lifting wing

Miranda, Joseph A., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Devenport, William J., Virginia Polytechnic Inst. and State Univ., Blacksburg; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 658-660; In English
Contract(s)/Grant(s): N00014-92-J-4087; N00014-94-1-0744
Report No.(s): AIAA Paper 96-0804; Copyright; Avail: Aeroplus Dispatch

Results of a study of a spiral wake similar to that of Devenport et al. (1996) are reported. The objective was to reveal precisely the effects of different three-dimensional influences that act on the spiral wake and to compare its structure with the near-two-dimensional region found further inboard. Both single- and two-dimensional measurements were made to this end. Here, results of the single-dimensional measurements are presented.
AIAA
Turbulent Wakes; Three Dimensional Flow; Lift; Vortices; Wing Tips

19980055392

An investigation of leading edge bluntness on a supersonic transport

Reimer, Heidi M., North Carolina State Univ., Raleigh, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0005; Copyright; Avail: Aeroplus Dispatch

A computational analysis of the effects of leading edge bluntness on supersonic cruise performance for a supersonic commercial transport aircraft has been conducted. Two wing planforms, each with 10 leading edge bluntness distributions, were analyzed at supersonic cruise speeds using the FLO57 Euler CFD code. Comparisons were made between performance characteristics of bluntness distributions for each planform. The results show that wing configurations with blunt inboard sections and sharp outboard sections perform the best, having little or no negative effect on supersonic cruise performance. The major benefits of leading edge bluntness are improved performance and efficiency at subsonic speeds, which are necessary for flight over land and on approach or departure from airports.
Author (AIAA)
Leading Edges; Supersonic Transports; Blunt Bodies; Wing Planforms; Computational Fluid Dynamics; Wing Profiles

19980055393

Analysis of ram accelerator flow using a Taylor-Maccoll conical solution

Williamson, Craig R., Purdue Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0006; Copyright; Avail: Aeroplus Dispatch

A model of the flow in a ram accelerator was developed based on a Taylor-Maccoll conical solution with simple inert and detonation shock models. This model was used to calculate the flow properties for a range of projectile Mach numbers in methane, oxygen and nitrogen propellant mixtures. One expected method of superdetonative operation is with an overdriven weak detonation shock reflecting off the tunnel wall. Mach numbers for this operation were found to be approximately 4.1 times the Chapman-Jouguet Mach number. At lower Mach numbers solutions are mathematically possible for overdriven weak detonation shocks off the bow of the projectile and strong detonation shocks reflected from the tunnel wall. Such solutions could lead to unstarts. The strong detonation solutions are in the same Mach number range as unstarts experienced in previous experiments. This model was found to be an effective tool to quickly estimate flow around a ram projectile and narrow further studies.
Author (AIAA)
Ram Accelerators; Computational Fluid Dynamics; Bow Waves; Shock Waves

19980055394

Numerical simulation of bow-shock/disturbance interactions in Mach-4 flows past a hemisphere

Dunn, John W., Texas, Univ., Austin, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0007; Copyright; Avail: Aeroplus Dispatch

Direct Navier-Stokes numerical simulations are being done of unsteady flows past a blunt body. These numerical simulations concentrate on the flow field around a hemispherical body after a perturbation or hotspot is introduced upstream of the bow-shock of the body. In the numerical simulations the hot-spot is produced by introducing an energy pulse in a cell of the computational grid along the stagnation line of the flow. Initial results suggest that pressure waves and vortex rings are generated in the subsonic region as a result of the hot-spot collision with the bow-shock of the body. The pressure waves are shown to be dependent on the energy level used to create the hotspot. The simulations seek to model recent experiments performed in a Mach 4 quiet-flow wind tunnel at Purdue University. During the experimental trials at Purdue, a laser-induced hot-spot generated similar pressure waves in the subsonic region near the stagnation point.

Author (AIAA)

Digital Simulation; Shock Waves; Bow Waves; Mach Number; Blunt Bodies; Navier-Stokes Equation

19980055397

Inlet-airfoil design method for heat exchangers of a high altitude RPA

Martin, Preston, Old Dominion Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0010; Copyright; Avail: Aeroplus Dispatch

This paper describes a methodology for designing a low drag inlet-airfoil to be used on the cooling installations of a high altitude environmental research aircraft. Since the primary design requirement for the aircraft is subsonic endurance at high altitude, the flight conditions present an aerodynamically unfavorable combination of low chord Reynolds number (below 500,000) and high subsonic Mach number (0.5). At this flight condition (altitudes in excess of 80,000 ft.), the inlet-airfoil must meet the heat exchanger cooling flow requirements while maintaining the aerodynamic performance of the airfoil. As a result, both the cooling flow and aerodynamic performance requirements are combined using the element circulations. The design method is closely coupled with not only the performance requirements, but also the basic flow physics of low Reynolds number flow (e.g., laminar separation bubbles). With an understanding of the critical flow features affecting the performance, sensible pressure distributions can be formulated. Using a multi-element airfoil design code, the geometry is then solved in the inverse mode by prescribing the desired pressure distribution. Using a current concept aircraft as a baseline, the method is used to develop an example design.

Author (AIAA)

Airfoil Profiles; Heat Exchangers; Remotely Piloted Vehicles; Research Aircraft; Cooling; Inlet Flow

19980055411

Numerical simulation of compressible synthetic jet flows

Cain, Alan B., Boeing Co., USA; Kral, Linda D., Washington Univ., USA; Donovan, John F., Boeing Co., USA; Smith, Timothy D., Boeing Co., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS1-20324

Report No.(s): AIAA Paper 98-0084; Copyright; Avail: Aeroplus Dispatch

Synthetic jets are examined over a speed range from incompressible to near-sonic. Increasing amplitude excitation is shown to produce increasingly strong acoustic waves. A context is introduced for discussing the relationship between acoustic waves and the vortical disturbances of the synthetic jet. A pulsed jet excitation of a near sonic plume is shown to produce a dramatic effect on mixing. Numerical simulation results are shown to be comparable with a reference experiment for this near sonic plume application.

Author (AIAA)

Digital Simulation; Compressible Flow; Jet Flow; K-Epsilon Turbulence Model

19980055418

A domain-decomposition method for airfoil flutter analysis

Beran, Philip S., USAF, Inst. of Technology, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0098; Copyright; Avail: Aeroplus Dispatch

A direct method is used to compute flutter boundaries for a NACA 64A006 airfoil with pitch-and-plunge structural coupling at transonic freestream Mach numbers assuming inviscid flow. The method is more efficient than previous implementations; performance is improved through a new composition of the governing equations and a new decomposition of the computational

domain. The algorithm solves an extended form of the Euler equations for the aeroelastic state at flutter onset, including flutter speed, flow solution and destabilizing eigenmode. The direct approach is seen to be orders of magnitude faster than an explicit, time-integration technqiue in predicting flutter speeds, and provides a relatively automated procedure that does not require bracketing of the flutter boundary, as true of time-domain techniques. Flutter speeds are obtained for a NACA 64A006 airfoil with 25 percent trailing-edge flap through the transonic-dip regime. Solutions are also reported for this airfoil at angle-of-attack. A sensitivity study is performed to assess the dependence of algorithm performance on subdomain quantity for decomposition in one computational coordinate.
Author (AIAA)
Airfoil Oscillations; Transonic Flutter; Flutter Analysis

19980055419

Large-eddy simulation of turbulent separated flows over an isolated air

Liu, Pei-Qing, Beijing Univ. of Aeronautics and Astronautics, China; Deng, Xue-Ying, Beijing Univ. of Aeronautics and Astronautics, China; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0099; Copyright; Avail: Aeroplus Dispatch

The large-eddy simulation is used to solve the separated flows over an NACA0012 isolated airfoil with the freestream Reynolds number of 2.8 x 10 exp 6 at angles of attack from 0 deg to 45 deg. Separated flow structures over the isolated airfoil and corresponding aerodynamic characteristics including pressure fluctuations at different angles of attack are presented in detail. In the numerical simulation, a weakly compressible flow model and the body-fitted grid technique are used.
Author (AIAA)
Turbulent Flow; Large Eddy Simulation; Separated Flow; Airfoil Profiles; Aerodynamic Characteristics; Pressure Oscillations

19980055420

On viscid-inviscid interaction modeling for airfoils as a numerical technique

Wolles, B. A., Delft Univ. of Technology, Netherlands; Hoeijmakers, H. W. M., Delft Univ. of Technology, Netherlands; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0100; Copyright; Avail: Aeroplus Dispatch

In the present study the problem of numerical viscid-inviscid interaction modeling is surveyed, analyzed and put in an encompassing context. A numerical viscid-inviscid interaction model has been implemented, composed of a full-potential and integral boundary-layer method. Both nonlinear mathematical models are treated simultaneously and the discretized form is solved with Newton’s method. Automatic differentiation is utilized, to compute the Jacobian matrix. While the flow along a finite flat plate, using a H-grid topology, is investigated as a model problem the external flow about an airfoil section, using a C-grid topology, is considered as the flow case of practical interest. Calculated results are presented for the trailing-edge region of a finite flat plate and for the flow around a NACA 0012 airfoil.
Author (AIAA)
Interactional Aerodynamics; Viscous Flow; Inviscid Flow; Airfoil Profiles; Boundary Integral Method; Jacobi Matrix Method

19980055421

The jet characteristics of a plunging airfoil

Lai, J. C. S., Australian Defence Force Academy, Australia; Platzer, M. F., U.S. Naval Postgraduate School, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0101; Copyright; Avail: Aeroplus Dispatch

The streamwise velocity field downstream of a NACA 0012 airfoil oscillated in plunge has been explored by dye flow visualization and single component LDV measurements for 54 combinations of three different freestream velocities, three different frequencies of oscillation, three different amplitudes of oscillation and two different sizes of the airfoil. Results indicate that provided that the reduced frequency is greater than 0.2, a jet instead of a wake is produced downstream of a plunging airfoil. The maximum jet velocity has been shown to be a linear function of the nondimensional plunge velocity. Quantitative mean velocity data for this flow field which has been hitherto unavailable in the literature has been documented.
Author (AIAA)
Airfoil Oscillations; Jet Flow; Velocity Distribution; Flow Visualization; Laser Doppler Velocimeters; Unsteady Aerodynamics

19980055424

CFD-FOIL - A computational environment for study of shape changing airfoils in unsteady flow

Hariharan, Nathan, CFD Research Corp., USA; Wang, Z. J., CFD Research Corp., USA; Sankar, L. N., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Contract(s)/Grant(s): DAAJ02-97-C-0013

Report No.(s): AIAA Paper 98-0108; Copyright; Avail: Aeroplus Dispatch

CFD-FOIL, an environment for the study of flow field around shape-changing airfoil geometries in unsteady flow, has been developed. The environment contains an in-built H-H multielement grid generator, multitime scale airfoil shape-changing modules, and an NS/FPE (Navier-Stokes/full potential equation) coupled solver with central difference and Roe flux option, all of which is packaged into a graphical interface with the capability for real-time visualization. This system allows a wide range of possible multiple time-scale shape variations that can be used independently or in combination. The methodology behind the development of CFD-FOIL is discussed, and demonstrations using a few selected cases are presented.

AIAA

Airfoil Profiles; Unsteady Flow; Helicopter Design; Aircraft Maneuvers; Grid Generation (Mathematics)

19980055425

A computational study of flow entrainment over a stationary/flapping airfoil combination in tandem

Tuncer, Ismail H., U.S. Naval Postgraduate School, USA; Lai, Joseph C. S., Australian Defence Force Academy, Australia; Platzer, Max F., U.S. Naval Postgraduate School, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0109; Copyright; Avail: Aeroplus Dispatch

Unsteady flowfields over a stationary/flapping airfoil combination in tandem are computed using a Reynolds averaged Navier-Stokes solver. The stationary leading airfoil has an experimental profile which promotes flow separation at its trailing edge. The effect of the flapping airfoil on the leading airfoil and the flow reattachment at the trailing edge are investigated by varying the amplitude and frequency of the flapping motion. A single deforming C-H type grid and overset grids are employed in the computations. Unsteady flowfields are presented in terms of Mach number contours and time histories of unsteady aerodynamic loads. The high frequency flapping motions, where the experimental data show complete flow reattachment at the trailing edge, could not be performed due to the time step limitation of the solver. However, the flow configurations studied produced a significant amount of flow entrainment at the trailing edge.

Author (AIAA)

Airfoil Profiles; Flapping; Reynolds Averaging; Trailing Edge Flaps; Reattached Flow; Aerodynamic Interference

19980055430

Implicit multigrid solution of the preconditioned multi-dimensional Euler equations

Muradoglu, Metin, Cornell Univ., USA; Caughey, David A., Cornell Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0114; Copyright; Avail: Aeroplus Dispatch

A new local preconditioning method based on the concept of artificial compressibility has been developed to accelerate the convergence to steady state solutions of the Euler equations of inviscid, compressible flow at low Mach numbers. An extension of the method to a matrix preconditioning which is effective over the range of Mach numbers from subsonic through low supersonic is also presented. The numerical results demonstrate that convergence rate is independent of Mach number in the range of M between 10 exp -5 and 0.6 while a significant improvement in convergence rate is also achieved in the transonic regime. In addition to the convergence benefits, the results also indicate that the preconditioning significantly reduces the numerical dissipation leading to more accurate solutions. The improvement in solution accuracy is more pronounced in the incompressible limit where the conventional algorithms are known to be inaccurate.

Author (AIAA)

Airfoil Profiles; Compressible Flow; Euler Equations of Motion; Multigrid Methods; Inviscid Flow

19980055431

Spurious numerical oscillations in numerical simulation of supersonic flows using shock capturing schemes

Lee, Theodore K., California, Univ., Los Angeles, USA; Zhong, Xiaolin, California, Univ., Los Angeles; Jan. 1998; In English

Contract(s)/Grant(s): F49620-95-1-0405; F49620-97-1-0030; NCC2-374

Report No.(s): AIAA Paper 98-0115; Copyright; Avail: Aeroplus Dispatch

The numerical simulation of transitional and turbulent processes in hypersonic boundary layers often involves a physical process of a shock-disturbance wave interaction in complex two-dimensional and three dimensional flow fields. For such simulations, it is required that there be a high order of accuracy in capturing both the shock and the small disturbances. The purpose of this

paper is to evaluate the viability of using high order shock capturing schemes to track small disturbances in a multi-dimensional steady hypersonic flow. The numerical methods that are to be studied are the Total Variation Diminishing (TVD) scheme, and Essentially Non-Oscillatory (ENO) scheme. This paper shows that the presence of numerical oscillations in the flow field solution may drastically hinder any attempt at tracking the propagation of any physical disturbances. It has been found that the numerical oscillations that exist for shock capturing methods may be significant enough to pollute a flow field containing small physical disturbances. The effects of the refinement of the grid do not reduce the oscillations, but rather they decrease the wavelength of the oscillations. It is shown that by aligning the shock with the grid, the amplitude of these spurious oscillations may be greatly reduced.
Author (AIAA)
Supersonic Flow; Shock Discontinuity; Hypersonic Boundary Layer; Turbulent Flow; Essentially Non-Oscillatory Schemes

19980055433
Computational simulation of a semispan wing in a wind tunnel
Olsen, Michael E., NASA Ames Research Center, USA; Rizk, Yehia, NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0119; Copyright; Avail: Aeroplus Dispatch
The computational simulation of wind tunnel tests are central in efforts to improve the accuracy and range of applicability of CFD codes. A validation experiment in solid wall transonic wind tunnel is simulated with the inviscid and viscous tunnel wall computation models. Viscous wall modeling appears to provide the ability to reproduce the experimental conditions fairly well without wall interference corrections but specification of the actual wall geometry is crucial.
Author (AIAA)
Wing Span; Transonic Wind Tunnels; Wind Tunnel Tests; Wind Tunnel Walls; Turbulence Models

19980055436
A variable-domain variational formulation of inverse problem of 2-D unsteady transonic flow around oscillating airfoils
Liu, Gao-Lian, Shanghai Univ., China; Guo, Jia-Hong, Shanghai Univ., China; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0124; Copyright; Avail: Aeroplus Dispatch
It is the purpose of the present paper to carry out, for the first time, a detailed theoretical investigation on the inverse problem in unsteady aerodynamics. Special attention is paid to finding proper ways of problem-posing and mathematical formulation. to fix basic idea, only an inverse problem of type IA of unsteady transonic flow with shocks around oscillating airfoils is studied herein. It has been formulated by a family of variational principles (VP) with variable domain, in which all unknown boundary (airfoil contour) and discontinuities (shocks and free trailing vortex sheets) are handled (captured) via the functional variation with variable domain. As a result, almost all boundary and interface conditions have been converted into natural ones. Thus, a rigorous theoretical basis for unsteady airfoil design and finite element (FE) applications is provided. On the basis of these variational principles developed in this paper, a method using new self-deforming finite element is suggested for the numerical realization of the variable-domain variation of the functional and a numerical example is given. Its suitability and effectiveness are really demonstrated by the numerical results.
Author (AIAA)
Transonic Flow; Variational Principles; Unsteady Aerodynamics; Airfoil Oscillations; Oscillating Flow

19980055439
High-order semi-implicit simulation of hypersonic boundary layer stability and transition
Dong, Haibo, California, Univ., Los Angeles, USA; Zhong, Xiaolin, California, Univ., Los Angeles; Jan. 1998; In English
Contract(s)/Grant(s): F49620-95-1-0405; F49620-97-1-0030
Report No.(s): AIAA Paper 98-0127; Copyright; Avail: Aeroplus Dispatch
This paper presents and evaluates a semiimplicit method for efficient and high-order accurate computations for the stability and transition of hypersonic boundary layers. For this problem, global implicit methods are seldom used because they take a prohibitively large amount of CPU time and large memory to convert full implicit equations. In the current method, the spatial discretization of the governing equations is separated into stiff terms involving derivatives along the wall-normal direction and nonstiff terms of the rest. The split equations are then advanced in time using second or third-order semiimplicit schemes so that implicit methods are used to treat the stiff terms while more efficient explicit methods can still be used for the nonstiff terms. The strict limitation on time steps due to fine grids in the wall-normal direction is removed by semiimplicit method so that the time steps

only depend on the grid spacing in the streamwise direction and accuracy requirement. The efficiency and accuracy of the new semiimplicit algorithm have been tested in computing the unsteady Navier-Stokes equations for several cases.
Author (AIAA)
Hypersonic Boundary Layer; Boundary Layer Stability; Boundary Layer Transition; Computational Fluid Dynamics

19980055440

An implicit essentially nonoscillatory method for the direct simulation of supersonic turbulent boundary layers

Weirs, W. G., Minnesota, Univ., Minneapolis, USA; Olejniczak, Debra J., Minnesota, Univ., Minneapolis; Candler, Graham V., Minnesota, Univ., Minneapolis; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0129; Copyright; Avail: Aeroplus Dispatch

A numerical method for the direct simulation of supersonic turbulent boundary layers is being developed in which a weighted, essentially nonoscillatory shock-capturing scheme with low dissipation is combined with a time-accurate, implicit solution advancement technique and implemented on a massively parallel supercomputer. Temporal boundary layer simulations at Mach 2 and 4 validate the numerical method for situations in which Morkovin's hypothesis holds. These test conditions are used so that the traditional methods used as baselines for comparison are reliable. The DP2 time-integration scheme uses 15 percent of the CPU time of the Runge-Kutta method and yields essentially identical results. For the flux Jacobian implemented here, the adaptive solutions are in excellent agreement with those predicted by a high-order upwind-biased spatial differencing scheme, and turbulent fluctuations are not damped significantly. The implicit, essentially nonoscillatory method described is promising for direct simulations of supersonic turbulent boundary layers.
Author (AIAA)
Essentially Non-Oscillatory Schemes; Supersonic Boundary Layers; Turbulent Boundary Layer; Computational Fluid Dynamics

19980055443

Euler computations on unstructured quadrilateral grids by a staggered-grid Chebyshev method

Kopriva, David A., Florida State Univ., Tallahassee, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0132; Copyright; Avail: Aeroplus Dispatch

A high order staggered-grid Chebyshev multidomain method is used to compute the Euler gasdynamics equations on unstructured quadrilateral meshes. New results show that the method reduces to the first-order upwind scheme when zeroth-order polynomial approximations are used, and that by a simple reconstruction procedure the standard Chebyshev collocation method can be recovered. Local time-stepping can be used to accelerate convergence to steady-state. Examples include flow over a circular bump, a NACA 0012 airfoil, and a three-element high lift configuration model.
Author (AIAA)
Euler Equations of Motion; Computational Grids; Chebyshev Approximation; Gas Dynamics

19980055444

Compressible Navier-Stokes computations on unstructured quadrilateral grids by a staggered-grid Chebyshev method

Kopriva, David A., Florida State Univ., Tallahassee, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0133; Copyright; Avail: Aeroplus Dispatch

We describe a new spectral multidomain method for the solution of the compressible Navier-Stokes equations. Within each subdomain, the method collocates the solution unknowns and the gradients at the nodes of the Gauss-Chebyshev quadrature. The total fluxes are evaluated at the nodes of the Gauss-Lobatto quadrature. Both conforming and nonconforming subdomain grids are allowed. Two examples are included to show the behavior of the method. First, exponential convergence is shown for the Couette flow on an unstructured grid quadrilateral grid. Next, subsonic flow over a backward facing step is solved on a nonconforming grid, and a comparison to experiments is made.
Author (AIAA)
Compressible Flow; Navier-Stokes Equation; Computational Grids; Chebyshev Approximation; Spectral Methods

19980055445

Upwind strategies for the Euler equations based on characteristic analysis

Zhang, X. D., CERCA; Ecole Polytechnique, Canada; Trepanier, J.-Y., CERCA; Ecole Polytechnique, Canada; Camarero, R., CERCA; Ecole Polytechnique, Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0134; Copyright; Avail: Aeroplus Dispatch

Different upwind strategies based on characteristic analysis are presented. Their performance concerning solution accuracy, grid independence and convergence behavior are investigated and compared through various types of problems, including subsonic, transonic and supersonic flows.
Author (AIAA)
Upwind Schemes (Mathematics); Euler Equations of Motion; Method of Characteristics

19980055447
Some recent advances in aerodynamics of DLR
Koerner, H., German Aerospace Research Establishment, Inst. of Design Aerodynamics, Germany; Radespiel, R., German Aerospace Research Establishment, Inst. of Design Aerodynamics, Germany; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0136; Copyright; Avail: Aeroplus Dispatch
The paper gives an overview of recent advances in aerodynamics at DLR. First, progress in the development of simulation concepts is described. This is followed by an appraisal of progress in numerical, experimental and applied technologies. Finally, an overview of aerodynamic design work on new configurations is given. The outlook from the present status of these matters concludes the paper.
Author (AIAA)
Aerodynamics; Computerized Simulation; Aircraft Models; Aircraft Design

19980055448
Recent advances in computational aerodynamics at NLR
Oskam, B., National Aerospace Lab., Netherlands; Slooff, J. W., National Aerospace Lab., Netherlands; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0138; Copyright; Avail: Aeroplus Dispatch
The objective of the present paper is to present a number of recent advances in computational aerodynamics at NLR. Five subject areas are highlighted: the multiblock structured grid approach, structured grid adaptation, the hybrid prismatic/tetrahedral grid approach, crew rescue/crew transport vehicle design, and unsteady computational aerodynamics. The recent advances in these subject areas are presented in terms of (1) CFD-code functionality, (2) fast CFD problem-turnaround-time and (3) high accuracy. The superior potential accuracy of multiblock structured-grid based CFD is discussed and found to be complemented by the superior, potential CFD problem turnaround time of the hybrid prismatic/tetrahedral grid approach.
Author (AIAA)
Aerodynamics; Computational Fluid Dynamics

19980055475
Aerothermodynamics of the Stardust sample return capsule
Olynick, Dave, NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0167; Copyright; Avail: Aeroplus Dispatch
The aerothermodynamics of the Stardust sample return capsule along Stardust's 12.6 km/s Earth entry trajectory is investigated. Full Navier-Stokes flow solutions with and without coupled ablation are generated for the forebody and afterbody of the sample return capsule. The effects of chemistry modeling, CO2 catalysis, mass blowing rate, and geometry modifications on the forebody and afterbody aerothermal environments are studied. It is demonstrated that increasing or decreasing the forebody cone angle has the largest effect on the afterbody heating. A major conclusion of the paper is that the afterbody heating is an inviscid effect and is primarily a function of the forebody shock stand-off distance and shock angle near the shoulder. For the cases considered in this work, it is shown that a relationship does not exist, between the forebody stagnation heating and the afterbody stagnation heating.
Author (AIAA)
Aerothermodynamics; Reentry Trajectories; Space Capsules; Afterbodies; Comets; Forebodies

19980055476
Coupled fluid/thermal prediction of ablating hypersonic vehicles
Hassan, Basil, Sandia National Labs., USA; Kuntz, David W., Sandia National Labs., USA; Potter, Donald L., Sandia National Labs., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0168; Copyright; Avail: Aeroplus Dispatch
A coupled fluid/thermal capability is described for predicting the ablation of hypersonic vehicles. The solution technique is achieved by coupling a CFD code and a material thermal response code through mass and energy balances at a common interface. Results presented in this paper employ an equilibrium chemistry ablation model for materials without in-depth conduction. Gas-

eous products of ablation are injected into the flow field and are allowed to react with the high temperature gases in thermo-chemical nonequilibrium that exist near the receding surface. The predicted surface recession is calculated on an axisymmetric carbon-carbon sphere-cone nosetip over a given trajectory.
Author (AIAA)
Hypersonic Vehicles; Ablation; Prediction Analysis Techniques; Reentry Vehicles; Aerothermodynamics; Aerothermochemistry

19980055477

Numerical and experimental investigation of the reduction of hypersonic nose tip ablation

Silton, Sidra I., Texas, Univ., Austin, USA; Goldstein, David B., Texas, Univ., Austin; Jan. 1998; In English
Contract(s)/Grant(s): DAAL21-93-C-0101
Report No.(s): AIAA Paper 98-0169; Copyright; Avail: Aeroplus Dispatch

To reduce the severe heating and ablation at the nose tip of a hypersonic vehicle, the introduction of a forward-facing cavity into the nose tip is explored. In the present joint numerical/experimental study, the effects of the cavity on ablation are explicitly addressed, whereas previous studies have concentrated on heating rates alone. Numerical and experimental results agree surprisingly well for a baseline hemisphere cylinder case.
Author (AIAA)
Nose Tips; Ablation; Hypersonic Vehicles; Cavities

19980055478

Aerothermal heating predictions for Mars Microprobe

Mitcheltree, R. A., NASA Langley Research Center, USA; DiFulvio, M., NASA Langley Research Center, USA; Horvath, T. J., NASA Langley Research Center, USA; Braun, R. D., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0170; Copyright; Avail: Aeroplus Dispatch

A combination of computational predictions and experimental measurements of the aerothermal heating expected on the two Mars Microprobes during their entry to Mars are presented. The maximum, nonablating, heating rate at the vehicle's stagnation point (at alpha = 0 deg) is predicted for an undershoot trajectory to be 194 W/sq cm with associated stagnation point pressure of 0.064 atm. Maximum stagnation point pressure occurs later during the undershoot trajectory and is 0.094 atm. From computations at seven overshoot-trajectory points, the maximum heat load expected at the stagnation point is near 8800 J/sq cm. Heat rates and heat loads on the vehicle's afterbody are much lower than the forebody. At 0-deg angle of attack, heating over much of the hemispherical afterbody is predicted to be less than 2 percent of the stagnation point value. Good qualitative agreement is demonstrated for forebody and afterbody heating between CFD calculations at Mars entry conditions and experimental thermographlc phosphor measurements from the Langley 20-Inch Mach 6 Air Tunnel. A novel approach which incorporates 6-DOF trajectory simulations to perform a statistical estimate of the effect of angle-of-attack, and other off-nominal conditions, on heating is included.
Author (AIAA)
Mars Probes; Aerothermodynamics; Prediction Analysis Techniques; Atmospheric Entry; Mars Atmosphere; Computational Fluid Dynamics; Temperature Measurement

19980055479

Analysis of hypersonic viscous flow about bluff cylinders place one after another

Yegorov, I. V., TsAGI, Russia; Yegorova, M. V., TsAGI, Russia; Riabov, V. V., Daniel Webster College, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0171; Copyright; Avail: Aeroplus Dispatch

The flow structure around two bluff cylinders placed one after another in a hypersonic viscous flow is studied. Grid equations approximating the Navier-Stokes equations were solved numerically by application of the implicit monotonized scheme of second-order accuracy, the modified Newton's method, and the Christoffel-Schwarz grid-transformation technique. Changes in temperature, pressure, and velocity fields in the wakes behind the cylinders, as well as skin friction and heat flux along cylinder surfaces, are analyzed.
Author (AIAA)
Hypersonic Flow; Viscous Flow; Bluff Bodies; Cylinders; Flow Distribution

19980055501

Arcjet flow properties determined from laser-induced fluorescence of atomic nitrogen

Fletcher, Douglas G., NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0205; Copyright; Avail: Aeroplus Dispatch

Flow property measurements that were recently acquired in the Ames Research Center Aerodynamic Heating Facility arcjet using two-photon laser-induced fluorescence (LIF) of atomic nitrogen (N) are reported. The flow properties, which include velocity, translational temperature, and N concentration, were measured simultaneously over a range of facility operating conditions for N2/argon test gas flows in the 30.5-cm-diameter nozzle. When combined with information from facility measurements, an analysis of the flow properties obtained using two-photon LIF of N yields the total free stream flow enthalpy.
Author (AIAA)
Flow Measurement; Laser Induced Fluorescence; Nitrogen Atoms; Gas Flow

19980055504

Aerodynamic flow control using synthetic jet technology

Amitay, Michael, Georgia Inst. of Technology, Atlanta, USA; Smith, Barton L., Georgia Inst. of Technology, Atlanta; Glezer, Ari, Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Contract(s)/Grant(s): F49620-96-1-0194
Report No.(s): AIAA Paper 98-0208; Copyright; Avail: Aeroplus Dispatch

The manipulation of global aerodynamic forces on bluff bodies using surface fluidic actuators based on synthetic jets technology is demonstrated in wind tunnel experiments using a 2D cylinder model. Because synthetic jets are zero-mass-flux and are synthesized from the working fluid in the flow system in which they are embedded, their interaction with a cross flow results in the formation of closed recirculation regions and in an apparent modification of the surface shape (and thus of surface pressure) with important consequences to flow separation. In the present experiments, the cylinder is instrumented with a pair of spanwise jet actuators and can be rotated about its centerline so that the angle between the jets and the direction of the free stream can be continuously varied. Azimuthal distributions of surface pressure measurements at Re(D) up to 131,000 over a range of jet angles demonstrate that the jets effect a substantial increase in lift and a reduction in drag. Velocity measurements in the near wake show that as a result of the actuation, the cross stream extent of the wake, its velocity deficit, and all turbulent quantities are reduced. The response of the lift force and of the wake flow to a transient change in the control input are also investigated using pulsed amplitude modulation.
Author (AIAA)
Aerodynamic Forces; Bluff Bodies; Wind Tunnel Tests; Working Fluids; Jet Control

19980055505

Modification of lifting body aerodynamics using synthetic jet actuators

Smith, Douglas R., Georgia Inst. of Technology, Atlanta, USA; Amitay, Michael, Georgia Inst. of Technology, Atlanta; Kibens, Valdis, Boeing Co., USA; Parekh, David, Georgia Inst. of Technology, Smyrna; Glezer, Ari, Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Contract(s)/Grant(s): F49620-96-1-0194
Report No.(s): AIAA Paper 98-0209; Copyright; Avail: Aeroplus Dispatch

The control of separated flow on an unconventional airfoil using synthetic jet actuators was investigated experimentally. A symmetric airfoil based on the aft portion of a NACA four-digit series airfoil with a cylindrical leading edge was used in the experiment. The tests were conducted at Re(c) of 3 x 10 exp 5. For alpha not less than 5 deg, the flow separated from the airfoil surface. Applying synthetic jet control near the leading edge, upstream of the separation point, reattached the separated flow for angle of attack up to 18 deg. The effect of control location and amplitude was investigated for different angles of attack. Hot wire measurements in the near-wake of the airfoil revealed a transient passing of vortices associated with the transition from separated to reattached flow on the airfoil.
Author (AIAA)
Lifting Bodies; Separated Flow; Airfoil Profiles; Actuators; Jet Control

19980055506

Active flow control applied to an airfoil

Donovan, John F., Boeing Co., USA; Kral, Linda D., Washington Univ., USA; Cary, Andrew W., Boeing Co., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20342
Report No.(s): AIAA Paper 98-0210; Copyright; Avail: Aeroplus Dispatch

Results of numerical simulations of active flow control applied to an airfoil using the Reynolds-averaged Navier-Stokes equations are presented. The simulations are first compared with the poststall separation control experiments of Seifert et al. (1996, 1997) on a NACA0015 at 1.2 x 10 exp 6 chord Reynolds number. The jet is introduced tangential to the surface at the leading edge

of the airfoil. The calculated lift increments are in good agreement with the experimental data. Two flow-control techniques for a NACA0012 airfoil at a chord Reynolds number of 8.5 x 10 exp 6 are investigated. The first technique utilizes a small, 0.5 percent chord, steady jet, and the second method employs a synthetic jet of a similar scale. Performance benefits are obtained by placing the actuators very near the airfoil leading edge on the suction surface. A significant increase in lift (29 percent) is obtained using the synthetic jet actuator in the poststall regime. At lower lift, the steady jet actuator significantly reduces drag by rotating the lift vector upstream.
Author (AIAA)
Active Control; Airfoil Profiles; Digital Simulation; Navier-Stokes Equation; Lift

19980055508
Synthetic-jet microblowing for forebody flow-asymmetry management
Roos, Frederick W., Boeing Co., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0212; Copyright; Avail: Aeroplus Dispatch

Low-speed wind tunnel experiments were conducted to evaluate the effect of periodic pulsing on microblowing vortex-asymmetry control, and to explore the applicability of zero-net-mass-flux ’synthetic’ jets to the microblowing method of forebody vortex control. The pulsed microblowing experiments showed that, within the range of pulsing frequencies studied, microblowing-induced asymmetry levels are determined by the average control-jet mass flow rate, reinforcing the earlier conclusion that the displacement, or ’virtual shaping’, effect of the microblowing mass flow governs the physics of this form of pneumatic forebody vortex management. The synthetic-jet experiments demonstrated that zero-net-mass-flux jets are as effective as steady jets of equivalent mean mass flow rate in manipulating the high-angle-of-attack vortex (and force) asymmetry on a hemisphere-cylinder forebody. This synthetic-jet approach to pneumatic asymmetry control can eliminate the need for any form of on-board control-jet gas supply and associated plumbing.
Author (AIAA)
Blowing; Forebodies; Asymmetry; Low Speed Wind Tunnels; Jet Control

19980055516
Know your flow - The key to better prediction and successful innovation
Haines, A. B., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0221; Copyright; Avail: Aeroplus Dispatch

A review is presented of selected items of recent and current aerodynamic research in the UK. The primary aims of much of this research are to improve the ability to predict the performance of sweptback wing designs for civil and military aircraft and to develop innovative concepts to improve this performance. Topics discussed include the prediction of scale effect between wind-tunnel and full-scale, the active or passive control of shock strength, schemes for the alleviation of different forms of boundary layer separation, the optimization of wing-nacelle installations, and concepts such as wings designed for extensive laminar flow and all-wing layouts. The emphasis throughout is on planning of research and interpretation of its results based on a clear, detailed understanding of the flow over the configuration.
Author (AIAA)
Aerodynamics; Research and Development; UK; Performance Prediction; Swept Wings; Aircraft Design; Aircraft Performance

19980055517
Evolutionary computational methods for complex design in aerodynamics
Mantel, B., Dassault Aviation, France; Periaux, J., Dassault Aviation, France; Stoufflet, B., Dassault Aviation, France; Sefrioui, M., Dassault Aviation, St. Cloud; Paris VI, Univ., France; Desideri, J.-A., INRIA, France; Lanteri, S., INRIA, France; Marco, N., INRIA, France; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0222; Copyright; Avail: Aeroplus Dispatch

This paper describes how new evolutionary tools such as genetic algorithms (GAs) can solve complex optimization problems in the aerospace industry. With the increasing demand for high innovation rates for new and improved products, there is a constant pressure to reduce the costs and time for marketing. Concurrent engineering and multidisciplinary design optimization on distributed parallel computers are emergent tools for the reduction of time cycle design which can drastically contribute to those industrial targets. Robustness of search algorithms is moving to extract global solutions from rugged multidimensional landscapes. Based on Darwin’s natural selection principle and digital DNA representation, the GA approach is a new sharing-information technique. The blending of stochastic properties of genetic operators with a deterministic fitness classification of individuals guarantees diversity for GAs and makes them able to escape local minima where traditional methods fail. Therefore, they produce a

much larger optimization effort. Numerical results are presented for the global solution of complex optimization or control problems.
Author (AIAA)
Aircraft Design; Genetic Algorithms; Aerospace Industry; Computer Techniques; Evolution (Development)

19980055519

Recent advances in aerodynamics inside the NSMB (Navier Stokes Multi Block) consortium

Vos, J. B., Swiss Federal Inst. of Technology, Switzerland; Rizzi, A. W., Royal Inst. of Technology, Sweden; Corjon, A., CERFACS, France; Chaput, E., Aerospatiale - Avions, France; Soinne, E., Saab AB, Sweden; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0225; Copyright; Avail: Aeroplus Dispatch

Since June 1992, a joint research project to develop a multiblock Navier-Stokes solver, called NSMB, is being carried out by two universities, one research establishment, and two industries in Europe. This paper gives a short overview of the numerical and physical modelling available in NSMB. The structure of NSMB is discussed, and particular attention is given to the use of parallel computers. Examples of complex external flows calculated by the different NSMB partners are given. The paper is concluded with a summary of ongoing research activities.
Author (AIAA)
Aerodynamics; Navier-Stokes Equation; Computational Fluid Dynamics; Multigrid Methods

19980055520

PNS algorithm for solving supersonic flows with upstream influences

Miller, James H., Iowa State Univ., Ames, USA; Tannehill, John C., Iowa State Univ., Ames; Lawrence, Scott L., NASA Ames Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS2-14327
Report No.(s): AIAA Paper 98-0226; Copyright; Avail: Aeroplus Dispatch

A new parabolized Navier-Stokes (PNS) algorithm has been developed to compute supersonic flows with embedded regions that produce upstream effects. Innovative techniques are used to automatically detect and measure the extent of the embedded regions. Within the embedded regions, the PNS equations are globally iterated to duplicate the results that would be obtained with the complete Navier-Stokes (NS) equations. Once an embedded region is computed, the algorithm returns to the standard space-marching PNS mode until the next embedded region is encountered. This procedure has been successfully incorporated into NASA's upwind PNS ('UPS') code, and has been applied previously to ramp and shock-impingement flowfields. In the present study, this algorithm has been extended to include expansion corner flowfields and to body shapes producing multiple embedded regions in the flowfield. The results computed using this approach are in excellent agreement with NS results obtained using the OVERFLOW code.
Author (AIAA)
Supersonic Flow; Upstream; Algorithms; Parabolic Differential Equations; Navier-Stokes Equation; Computational Fluid Dynamics

19980055521

Grid adaptation for shock/turbulent boundary layer interaction

Qin, N., Cranfield Univ., UK; Zhu, Y., Cranfield Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0227; Copyright; Avail: Aeroplus Dispatch

To avoid unfair judgement of different turbulence models, a structured grid adaptation method is proposed to address the grid sensitivity of the numerical results. In particular, we studied the grid sensitivity of the two-equation shear-stress transport model for Delery Bump Case C. The results are analyzed with regard to the improvement of the general flow features, the surface pressure distributions, the velocity and the turbulence shear stress profiles in the boundary layer within and downstream of the interaction region. Numerical errors and physical discrepancies between the model and the experiment have been identified.
Author (AIAA)
Shear Stress; Stress Propagation

19980055523

Adaptive finite element solution of compressible turbulent flows

Ilinca, F., National Research Council of Canada, Industrial Materials Inst., Boucherville, Canada; Pelletier, D., Ecole Polytechnique, Canada; Ignat, L., Ecole Polytechnique, Canada; Jan. 1998; In English
Contract(s)/Grant(s): F49620-96-1-0329

Report No.(s): AIAA Paper 98-0229; Copyright; Avail: Aeroplus Dispatch

This paper presents an adaptive FEM for solving compressible turbulent flows. Pressure based methods previously developed for laminar compressible flows and turbulent incompressible flows are combined to solve compressible turbulent flows. Turbulence is modeled by the k-epsilon model. The algorithm uses the logarithms of k and epsilon as computational variables to preserve positivity. Solutions are obtained in primitive variables using quadratic finite elements on unstructured grids. The error is estimated by a local projection method. The solution algorithm and error estimation are validated on problems with known analytical solutions. The method is then applied to compressible subsonic and transonic flows and predictions are compared with experimental measurements.

Author (AIAA)

Finite Element Method; Compressible Flow; Turbulent Flow; Computational Fluid Dynamics

19980055524

Modified flux-difference splitting for simulating low Mach number flows, including combustion, on unstructured grids

Currie, T. C., National Research Council of Canada, Aerodynamics Lab., Ottawa, Canada; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0230; Copyright; Avail: Aeroplus Dispatch

The simulation of low Mach number (Ma) flows, including those with combustion, using a simple implementation of Roe’s (1981) flux-difference splitting on unstructured grids is described. Roe’s scheme is modified to reduce numerical diffusion at low Ma. Time integration of the primitive variables is performed by implicit time-marching with an artificial compressibility which is approximately equal to the true compressibility. The implicit equations are solved using symmetric Gauss-Seidel iteration, which is convergent with large CFL numbers (scaling with Ma exp -2) because of the strong diagonal dominance provided by Roe’s scheme. The procedure is used to simulate a variety of flow types and speeds, including combustion in a complex gas turbine combustor, to demonstrate its potential.

Author (AIAA)

Flux Difference Splitting; Mach Number; Combustible Flow; Computational Grids; Computational Fluid Dynamics

19980055526

Navier-Stokes computations of HSCT off-design aerodynamics using unstructured grids

Kano, Shintaro, Tohoku Univ., Japan; Nakahashi, Kazuhiro, Tohoku Univ., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0232; Copyright; Avail: Aeroplus Dispatch

The capability of an unstructured hybrid grid method to compute the compressible Navier-Stokes equations is discussed for vortical flows over slender delta wings at low subsonic, high-alpha conditions as a basic study of off-design aerodynamics of HSCT (High-Speed Civil Transport) configurations. These flows require high resolutions of the boundary layers on the wing and of the vortical flow region above the wing. The unstructured hybrid grid, which is composed of prismatic grid in boundary layers and tetrahedral and pyramidal grids for the remaining region, is used to wear such viscous flows. The compressible Navier-Stokes equations are solved on the hybrid grid by a cell-vertex, upwind finite volume method. The LU-SGS implicit time integration scheme is used for the convergence acceleration to the steady state. The numerical accuracy of the present method is discussed by comparing with the experimental data of the same configurations. It is demonstrated that the present hybrid grid method is efficient and accurate enough to predict the vortical flow fields over the delta wings. The capability of the method is also shown for a HSCT configuration at a low subsonic, high alpha condition.

Author (AIAA)

Aerodynamic Configurations; Navier-Stokes Equation; Computational Grids; Aircraft Design; Vortices

19980055535

Combined schlieren and OH PLIF imaging study of ram accelerator flowfields

Morris, C. I., Stanford Univ., USA; Kamel, M. R., Stanford Univ., USA; Ben-Yakar, A., Stanford Univ., USA; Hanson, R. K., Stanford Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0244; Copyright; Avail: Aeroplus Dispatch

OH planar laser-induced fluorescence (PLIF) and schlieren imaging were applied to investigate shock-induced combustion phenomena on a 40-deg wedge in an expansion tube. OH PLIF was used to determine the regions of combustion in the flow field, while schlieren imaging provided complementary shock wave visualization. Stoichiometric H2/O2 gas mixtures were tested at two different test flow conditions. A pressure transducer was mounted in the wedge to obtain a record of the surface pressure history on the model. Three test cases yielded shock-induced combustion behind an attached shock at the tip of the wedge. Depending on the sensitivity of the mixture employed, the flame front either rapidly converged with the shock, or slowly diverged away from it. The measured wave angles and surface pressures in these tests were, in general, well-modeled by shock-polar theory using fro-

zen thermochemistry. Two other test cases, using the most sensitive gas mixtures, produced a closely-coupled flame front behind a detached shock wave near the wedge tip. The measured surface pressure in this latter case was better modeled by a shock polar using equilibrium chemistry. Simple finite-rate chemistry modeling of the ignition zone agrees with experimental results in all cases.
Author (AIAA)
Ram Accelerators; Flow Distribution; Schlieren Photography; Hydroxyl Radicals; Laser Induced Fluorescence; Flow Visualization; Combustion Chemistry; Shock Wave Interaction; Combustion Physics

19980055558

CFD code comparisons for Mars entry simulations

Papadopoulos, P., Thermosciences Inst., USA; Prabhu, D., Thermosciences Inst., USA; Olynick, D., NASA Ames Research Center, USA; Chen, Y. K., NASA Ames Research Center, USA; Cheatwood, F. M., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0272; Copyright; Avail: Aeroplus Dispatch

Axisymmetric and 3D Navier-Stokes solutions with CO2 thermochemistry models, catalytic and noncatalytic surface kinetics, have been computed for code-to-code comparisons between the GASPv3.0, GIANTS and LAURA codes, at the Mars 2001 overshoot peak-heating flight conditions. The following parameters and their effects on surface heating have been studied: gas kinetics, chemical reaction rates, diffusion rates, and wall catalysis models. The code-to-code comparative study indicates that the computed noncatalytic heating rates are influenced by the choice of chemical kinetics and transport models. For a nonablating surface, wall catalysis is an important mechanism for transferring energy to the surface of the vehicle. Surface kinetics and diffusion models drive surface heating to similar levels irrespective of differences in the gas kinetics models, thermal nonequilibrium or numerical algorithms. The calculated solutions show that surface catalysis contributes 60-70 percent of the total heating at the nonablating vehicle's surface, for the surface kinetics models compared.
Author (AIAA)
Mars Atmosphere; Atmospheric Entry; Computational Fluid Dynamics; Thermochemistry; Reaction Kinetics; Surface Reactions

19980055560

Effect of reaction mechanism in shock-induced combustion simulations

Clutter, J. K., Florida, Univ., Gainesville; Wilfred Baker Engineering, Inc., USA; Mikolaitis, David W., Florida, Univ., Gainesville; Shyy, Wei, Florida, Univ., Gainesville; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0274; Copyright; Avail: Aeroplus Dispatch

A steady-state, shock-induced combustion problem due to the Mach 6.46 flight of a blunt projectile in a stoichiometric hydrogen and air mixture is studied. Various mechanisms for the hydrogen-air reactions are tested to determine the impact the selection of reaction mechanism has on simulation accuracy. Characteristics of the mechanisms such as heat release rate and induction time are quantified using a zero-dimension analysis. The computed flow field is found to depend on the range of a Damkoehler parameter based on the induction time behind the shock. Results suggest factors which impact induction time, such as high-pressure effects in the reaction mechanisms, are key.
Author (AIAA)
Shock Heating; Fuel Combustion; Hydrogen Fuels; Reaction Kinetics; Combustible Flow

19980055561

Direct simulation of a 1-D shock with state-to-state rotational energy exchange

Altman, Aaron, Texas, Univ., Austin, USA; Varghese, Philip L., Texas, Univ., Austin; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0275; Copyright; Avail: Aeroplus Dispatch

One-dimensional Mach 3.5 and Mach 5 shocks are modeled in para-hydrogen using a Direct Simulation Monte Carlo (DSMC) method with quantum state-to-state collision cross-sections. Non-Boltzmann rotational population fractions were observed within the shock. The results are compared to a DSMC code using a Borgnakke-Larsen (B-L) energy exchange model. Both constant and temperature-variable rotational collision numbers were used in an attempt to match the behavior shown by the quantum state-resolved calculations. The B-L model with constant rotational collision number energy exchange generally failed to match the state-resolved calculations. A modiflied B-L model with temperature dependent collision number was also tested empirically to see if a better match could be obtained with the state-resolved calculations.
Author (AIAA)
Shock Wave Interaction; One Dimensional Flow; Rocket Exhaust; Rotational States; Para Hydrogen

19980055562

Numerical analysis of hypersonic aerodynamics for atmospheric re-entry problems of HOPE and HYFLEX

Yamamoto, Yukimitsu, National Aerospace Lab., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0277; Copyright; Avail: Aeroplus Dispatch

Numerical analyses of hypersonic flow around the HOPE (H-II Orbiting Plane) and HYFLEX (Hypersonic Flight Experiment) spacecraft are performed using perfect gas, frozen, and chemically nonequilibrium Navier-Stokes CFD codes. A parametric study is made to determine the basic configuration of HOPE-X, and the reliability of the present computations is confirmed through comparisons with the several hypersonic wind tunnel experiments. The evaluation of HYFLEX flight experiments is also performed by CFD-FEM coupling simulations, and it is found that aerothermal environments of this reentry flight are well simulated. For the real gas and viscous interaction effects, systematic investigations are made including real gas flow calculations along HOPE-X's planned flight trajectories.

Author (AIAA)

Hypersonic Reentry; Atmospheric Entry; Japanese Spacecraft; Hypersonic Flow; Aerodynamic Configurations; Spacecraft Design

19980055579

Mars Pathfinder rarefied aerodynamics - Computations and measurements

Moss, James N., NASA Langley Research Center, USA; Blanchard, Robert C., NASA Langley Research Center, USA; Wilmoth, Richard G., NASA Langley Research Center, USA; Braun, Robert D., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0298; Copyright; Avail: Aeroplus Dispatch

On July 4, 1997, after traveling close to 500 million km, the Pathfinder spacecraft successfully completed entry, descent, and landing at Mars. We focus on the hypersonic rarefied portion of Pathfinder's atmospheric entry, where the synergy of flight measurements, aerodynamic calculations, and atmospheric modeling tools are used to extract Pathfinder's attitude and the freestream density. Accuracy of the capsule aerodynamics directly impacts the inferred atmospheric properties extracted from deceleration measurements made by on-board accelerometers. The range of rarefaction considered extends from the free molecular to continuum conditions and angles of attack from 0 to 30 deg. The aerodynamic computations are made with free-molecular and direct simulation Monte Carlo codes. The calculations show that Pathfinder is statically unstable for much of the transitional rarefied regime. Due to the relatively modest forces and the gyroscopic motion of the spacecraft, the angle of attack excursions were less than 5 deg, (inferred from force measurements for the rarefied portion of entry), and approached a nominal zero-deg trim angle near hypersonic continuum conditions.

Author (AIAA)

Rarefied Gas Dynamics; Hypersonic Speed; Atmospheric Entry; Mars Atmosphere; Aerodynamic Characteristics

19980055593

Tunnel wall effect on the flow around a 76/40-deg double-delta wing

Verhaagen, Nick G., Delft Univ. of Technology, Netherlands; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0312; Copyright; Avail: Aeroplus Dispatch

The aerodynamic characteristics of the flow over a 76/40-deg double-delta wing, investigated in a subsonic wind tunnel, are described. Attention is given to the effect of tunnel walls on the flow around the double-delta wing. An overview is given of existing tunnel-wall correction methods for wings with leading-edge vortex separation. Methods are selected to estimate the wall corrections for the surface-pressure data of the double-delta wing. The corrected data agree reasonably well with data taken in a larger tunnel, and improve the correlation with numerical solutions.

Author (AIAA)

Wind Tunnel Walls; Delta Wings; Aerodynamic Characteristics; Subsonic Wind Tunnels; Fighter Aircraft

19980055595

Delay of vortex breakdown over a delta wing via near-core blowing

Guillot, S., Louisiana State Univ., Baton Rouge, USA; Gutmark, E. J., Louisiana State Univ., Baton Rouge; Garrison, T. J., Louisiana State Univ., Baton Rouge; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0315; Copyright; Avail: Aeroplus Dispatch

Injection of jets from nozzles embedded in a delta wing were used to add momentum into the core of the leading edge vortices and thus delay their breakdown. The tests were performed on a delta wing with a 60-deg sweep angle at a Reynolds number of 260,000 and angles of attack varying from 12 to 20 deg. At a typical alpha of 15 deg, the vortex breakdown location was moved

from its natural location at 55 percent of the wing chord to 90 percent near the trailing edge, using a blowing coefficient of -0.007. Though optimized for alpha = 15 deg, the jet blowing was effective in the entire range of angles of attack studied. Flow visualizations performed by illuminating smoke with a laser sheet showed the effect of jet blowing on the vortex core, and determined vortex trajectory and breakdown location. The mean axial velocity and turbulence intensity were mapped across the vortex at several axial locations using LDV. Vortex breakdown resulted in strong deceleration of the mean velocity in the core region, negative flow, and increased turbulence intensity. Fluctuations in the vortex breakdown location at a Strouhal number of 0.13 were recorded. Control jet injection accelerated the core velocity and stabilized the vortex, as evidenced by a reduction in the turbulence intensity and a substantial shift of the vortex breakdown location towards the trailing edge.
Author (AIAA)
Delay; Vortex Breakdown; Delta Wings; Blowing; Gas Injection; Flow Visualization

19980055596

Shear-layer effects on trailing vortices

Zheng, Z. C., South Alabama, Univ., USA; Baek, K., South Alabama, Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-1911
Report No.(s): AIAA Paper 98-0316; Copyright; Avail: Aeroplus Dispatch

Crosswind shear can influence the trailing vortex trajectories significantly, according to both field measurement and numerical simulations. Point vortex models are used here to study the fluid dynamic mechanism in the interactions between trailing vortex pair and shear layers. It has been shown that the shear-layer deformation causes the vortex descent history difference in the two vortices of the vortex pair. When a shear layer is below the vortex pair with the same sign as the left vortex, the right vortex descends less than the left vortex. When the same shear layer is above the vortex pair, the right vortex descends more. The descent altitudes of the two vortices are the same when they go through a constant, nondeformed shear layer. Those trends are in agreement with Navier-Stokes simulations.
Author (AIAA)
Shear Layers; Vortices; Atmospheric Turbulence; Atmospheric Stratification; Cross Flow; Wind Effects

19980055597

Large eddy simulation of the near wake of a rectangular wing

Youssef, K. S., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Ragab, S. A., Virginia Polytechnic Inst. and State Univ., Blacksburg; Devenport, W. J., Virginia Polytechnic Inst. and State Univ., Blacksburg; Abdel Gawad, A. F., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Contract(s)/Grant(s): N00014-92-4087; N00014-96-1-1139
Report No.(s): AIAA Paper 98-0317; Copyright; Avail: Aeroplus Dispatch

A model of the initial conditions in the near wake of a rectangular wing is devised to investigate mechanisms of turbulence production in the spiral wake around the core of a tip vortex. The model consists of a streamwise vortex sheet whose strength is found from Prandtl lifting line theory. Spanwise vorticity is represented by a Gaussian streamwise velocity profile that is superimposed on the field of the vortex sheet. The integrated spanwise vorticity of this profile is zero. The model is then used to initialize the flow field for temporal large-eddy simulation of the instabilities of the spanwise vorticity during roll-up. The results show that the sinuous mode prevails in the spiral wake around the core. The strength and streamwise length scale of the instability vary along the wake because of the continuous variation in its thickness. The large scale structures produced by the instability of the spiral wake cause the formation of undulations on the core, consistent with the hypothesis of Devenport et al. (1996).
Author (AIAA)
Large Eddy Simulation; Near Wakes; Rectangular Wings; Wing Tip Vortices; Turbulence

19980055598

Adaptive control of wingtip vortex

Matthewson, Charles S., Tennessee, Univ., Tullahoma, USA; Vakili, Ahmad D., Tennessee, Univ., Tullahoma; Gowanlock, Derek K., Tennessee, Univ., Tullahoma; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0318; Copyright; Avail: Aeroplus Dispatch

An experimental study of the effects of destabilizing the tip vortices from a model rotor blade using perturbations introduced by discrete jets located at the tips has been carried out. Measurements and flow visualizations were conducted on a static rotor test stand to study the potential effectiveness of discrete jets on rotor blades to reduce the effects of blade vortex interactions; this is a common problem in rotor aeroacoustics. Hot-film measurements in the near field wake of a 'hovering' rotor blade tip showed dramatic reductions in maximum velocities. Typical reductions observed were from 0.475 V(tip) (baseline) to 0.25 V(tip), with

blowing at C(mu) = 0.0033. Increased unsteadiness in the measured region of the vortex of the modified blade was also observed. Results from the experimental blade smoke flow visualization (within one rotor span) revealed outward radial movement of the vortex core in the vicinity of the rotor tip, for the case with tip blowing. Visualization also showed a reduction in the coherence of the vortices shed from the modified blade. Results obtained quantitatively and qualitatively show the potential benefits of discrete wingtip-blowing jets as a means for active or adaptive wake vortex control with changing flight conditions.
Author (AIAA)
Adaptive Control; Wing Tip Vortices; Rotor Blades; Blade-Vortex Interaction; Aeroacoustics

19980055599

An experimental study of the flow-field around an Apollo capsule at low speed

Wang, Frank Y., von Karman Inst. for Fluid Dynamics, Belgium; Karatekin, Ozgur, von Karman Inst. for Fluid Dynamics, Belgium; Charbonnier, Jean-Marc, von Karman Inst. for Fluid Dynamics, Belgium; Jan. 1998; In English
Contract(s)/Grant(s): NSF INT-96-00318
Report No.(s): AIAA Paper 98-0319; Copyright; Avail: Aeroplus Dispatch

Results of an exploratory investigation of the flowfield around an Apollo capsule at low speed are presented. Flow features were ascertained quantitatively in by LDV, DPIV, hot-wire measurements, as well as supplemented by flow visualizations. The study revealed a meandering vortex ring structure around the capsule, well-organized streamwise vortices whose strength increased in the recirculating wake before decaying further downstream, and the existence of multiple Strouhal numbers in the wake.
Author (AIAA)
Flow Distribution; Space Capsules; Flow Visualization; Laser Doppler Velocimeters; Particle Image Velocimetry; Apollo Project

19980055602

Investigation of supersonic jet exhaust flow by one- and two-equation turbulence models

Suzen, Yildirim B., Wichita State Univ., USA; Hoffmann, Klaus A., Wichita State Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0322; Copyright; Avail: Aeroplus Dispatch

High speed jet exhaust flow and its interaction with body- and/or fin-generated shock produce one of the most challenging flowfields. The flow domain includes shear layers, series of compression and expansion waves, shock waves, chemical reactions, equilibrium and/or nonequilibrium, multiphase flow, and finally, turbulence. At present, the ability to produce a comprehensive computer program addressing all aspects of the flowfield and resolving the details of the flow does not exist. A logical approach is to investigate each phenomenon separately and ultimately integrate these effects to produce an accurate model. In the present study, three recently developed one-equation and two-equation turbulence models are used to investigate their performance in supersonic jet flows. Several modifications to these models are incorporated in order to increase their performance for this type of flows. For the one-equation models, the modifications consist of changes in model coefficients. For two-equation models, modifications to include compressibility correction are considered. The solutions are compared to each other and available experimental dala. Flowfield simulation is on a multiblock grid system using a flux-vector splitting scheme.
Author (AIAA)
Supersonic Jet Flow; Exhaust Gases; Turbulence Models; Computational Fluid Dynamics; Navier-Stokes Equation

19980055604

Linear and non-linear turbulence models for shock-wave/turbulent boundary-layer interaction using a strongly coupled approach

Richardson, Giles, Cranfield Univ., UK; Qin, Ning, Cranfield Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0324; Copyright; Avail: Aeroplus Dispatch

This paper reports our progress in developing a framework based on a strongly coupled high resolution method for Reynolds averaged Navier-Stokes solutions with various linear and nonlinear eddy viscosity models. Two transonic, shock-wave/turbulent boundary layer interaction (STBLI) type problems are studied: the RAE8 airfoil (weak STBLI), and the Delery channel bump (strong STBLI). Several turbulence models were applied to both cases, and most yield good results for the airfoil case. However, linear two-equation turbulence models which assume the Boussinesq approximation are unable to accurately predict the anisotropy of turbulence which characterizes strong STBLI problems, such as the channel bump. The Shear Stress Transport (SST) model proved to be the most successful of the LEVMs for modeling the channel bump problem. We attribute the success of the SST model to the nonlinearity introduced by the switching between two linear models, and the inclusion of Bradshaw's assump-

tion for strong adverse pressure gradients. An explicit algebraic stress model gave the best overall results for the channel bump test-case, when used within the k-omega formulation with eddy viscosity limiting, according to Bradshaw's assumption.
Author (AIAA)
K-Epsilon Turbulence Model; Linear Systems; Nonlinear Systems; Turbulent Boundary Layer; Navier-Stokes Equation

19980055607

Evaluation of several turbulence models in a multiple-element airfoil computation

Woodruff, S. L., Florida State Univ., Tallahassee, USA; Hussaini, M. Y., Florida State Univ., Tallahassee; Morrison, J. H., Analytical Services and Materials, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0327; Copyright; Avail: Aeroplus Dispatch

In order to critically evaluate the current state of Reynolds-averaged Navier-Stokes computations in aerodynamic applications, the flow about a multielement high-lift airfoil configuration was computed using a state-of-the-art CFD code and several state-of-the-art turbulence models. A three-element airfoil (comprised of a slat, main element, and flap), for which experimental data is available, was chosen for this investigation, permitting the accuracy of the computational results to be assessed. The models employed were a k-epsilon model, a k-omega model, and an algebraic-stress model. The sensitivity of the results to such factors as transition location and outflow boundary conditions was also examined.
Author (AIAA)
Turbulence Models; Airfoil Profiles; Navier-Stokes Equation; Computational Fluid Dynamics

19980055610

Scaling of an oscillatory flow-control actuator

Lachowicz, Jason T., NASA Langley Research Center, USA; Yao, Chung-Sheng, NASA Langley Research Center, USA; Wlezien, Richard W., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0330; Copyright; Avail: Aeroplus Dispatch

An oscillatory flow control actuator is characterized in still air using flow visualization and mean velocity measurements. The actuator produces flow in several regimes that may be used for active flow control. The nondimensional scaling for each flow regime is developed. The scaling is general and may be applied to the design of other oscillatory flow control actuators (such as vortex generator jets or synthetic jets) by an appropriate interpretation of the nondimensional variables. The oscillatory flow control actuator generates a free jet, wall jet, vortex flow, or a combination of these flows depending on the scaling parameters. For the vortex flow field, the actuator operational range increases as the actuator size decreases, which may facilitate microactuator design. The optimum actuator efficiency occurs at a Stokes number of about 8 for the vortex flow.
Author (AIAA)
Oscillating Flow; Actuators; Flow Visualization; Velocity Measurement; Aircraft Performance

19980055611

Enhancement of large scale structures in supersonic axisymmetric jets using laser excitation

Elliott, Gregory S., Rutgers Univ., USA; Crawford, Jason, Rutgers Univ., USA; Mosedale, Andrew, Rutgers Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0331; Copyright; Avail: Aeroplus Dispatch

A novel way of controlling and forcing supersonic mixing layers is demonstrated. A laser beam from a frequency-doubled pulsed Nd:YAG laser is focused at the nozzle exit of an axisymmetric jet. Pulsing the laser causes a thermal peak at the jet surface, forcing the shear layer where it is formed. Measurements show that this is an effective means to enhance and control the large scale structures formed at the exit of perfectly expanded jets with Mach numbers of 1.36, 1.5, and 2. The convective Mach numbers of these jets are 0.63, 0.68, and 0.85, respectively. Two laser pulses are used: the first excites the flow, and the second, delayed in time and formed into a sheet, interrogates the flow for visualization. The convective velocity of the large scale structures was found to be slightly higher than predicted theoretically. Since the formation of the large scale structures can be controlled, high frequency pressure measurements were made simultaneously with each instantaneous image. The pressure trace indicates the lower and higher pressures associated with the vortex core and braid regions of the large scale structures, respectively. The laser excitation technique provides a unique opportunity to study the spatially stable large scale structures and a novel method for enhancing the growth rate of a supersonic shear layer.
Author (AIAA)
Supersonic Jet Flow; Axisymmetric Flow; Mixing Layers (Fluids); Laser Beams; Excitation

19980055613

An investigation of tailored upstream heating for sonic boom and drag reduction

Marconi, Frank, Northrop Grumman Corp., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0333; Copyright; Avail: Aeroplus Dispatch

The 'design' of heating distributions in front of a vehicle flying at supersonic speed is considered; the intent is sonic boom alleviation. The boom at the ground is to be replaced by a 'gradual' pressure rise. At altitude, the vehicle's shock system can be spread over as many as 10 vehicle lengths, and the pressure rise can be carefully controlled. Calculations have shown that control of the pressure rise in front of a supersonic aircraft can be achieved by atmospheric heating, which can be generated/projected by an onboard system. A natural outcome of the resulting shock elimination is a significant reduction in drag. This paper discusses computational results that demonstrate the type of tailored heating required for sonic boon alleviation. In addition, issues associated with the optimization of the heating distribution for drag reduction, boom alleviation, vehicle surface heating, and power requirements are discussed.

Author (AIAA)

Sonic Booms; Drag Reduction; Upstream; Temperature Effects; Supersonic Aircraft; Noise Reduction; Computational Fluid Dynamics

19980055615

A detailed comparison of non-parallel stability results with experimental data

Langlois, Marc, Bombardier Aerospace Group, Canada; MacDonald, Patric, Ecole Polytechnique, Canada; Casalis, Gregoire, ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Masson, Christian, Ecole de Technologie Superieure, Canada; Paraschivoiu, Ion, Ecole Polytechnique, Canada; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0335; Copyright; Avail: Aeroplus Dispatch

A detailed comparison of non-parallel stability results with experimental measurements is presented. to this end, a stability analyzer based on the linear, 3D, incompressible parabolized stability equations (PSEs) was developed. The PSE formulation takes into account the variations of the mean flow and disturbance quantities in the principal direction of the flow (typically the chordwise direction), resulting in a space-marching procedure subject to a normalization relation. In the PSE approach, the amplitude of a perturbation can be related to a 'physically measurable' quantity, a possibility that does not exist with the parallel stability theory. It is therefore expected that the PSE results may provide a better reproduction of some experimentally observed features, such as double-peaked spectra, than has so far been obtained using the parallel theory. In this article, fluctuation spectra obtained by the PSE approach on the ONERA AFVD 82 swept wing are compared to hot film experimental data. The predictions are shown to be dependent on the choice of the amplitude. The numerical results based on the wall-shear stress amplitude show much better qualitative and quantitative agreement with the measured spectra than those that use the fluctuating energy amplitude.

Author (AIAA)

Flow Stability; Transition Flow; Flow Measurement; Parabolic Differential Equations; Computational Fluid Dynamics

19980055616

Nonlinear stability of three-dimensional boundary layers

Kanke, Eric, Old Dominion Univ., USA; Balakumar, Ponnampalam, Old Dominion Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0337; Copyright; Avail: Aeroplus Dispatch

The stability of incompressible 3D boundary layers has been investigated using the parabolized stability equations (PSEs). We computed the evolution of stationary and traveling disturbances in the linear and nonlinear region prior to transition. As model problems, we chose the swept Hiemenz flow and the DLR-transition experiment. For the latter, the mean flow profiles were obtained by solving the boundary layer equations for the measured pressure distribution. A global and local eigenvalue solver using the implicitly restarted Arnoldi method and a Newton-Raphson technique, respectively, were developed for an investigation of the secondary instability in the region of nonlinear saturation. by including an unstable higher frequency mode in the primary analysis, we were able to capture essential flow features in the later stages of transition. For the DLR experiment, we present linear and nonlinear results, as well as results from the secondary instability analysis.

Author (AIAA)

Three Dimensional Boundary Layer; Flow Stability; Nonlinearity; Incompressible Flow; Parabolic Differential Equations

19980055617

Finite amplitude stability of attachment line boundary layers

Balakumar, P., Old Dominion Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0338; Copyright; Avail: Aeroplus Dispatch

Two-dimensional nonlinear equilibrium solutions for the swept Hiemenz flow attachment line boundary layer are directly computed by solving the full Navier-Stokes equations as a nonlinear eigenvalue problem. The equations are discretized using the two-point fourth-order compact scheme, and the resulting nonlinear homogeneous equations are solved using the Newton-Raphson iteration technique. It is found that for Reynolds numbers larger than the linear critical Reynolds number of 583, the nonlinear neutral surfaces form open curves. The results showed that the subcritical instability exists near the upper branch neutral curve, and supercritical equilibrium solutions exist near the lower branch. These conclusions are in agreement with the weakly nonlinear theory. However, at higher amplitudes away from the linear neutral points, the nonlinear neutral surfaces show subcritical instability at lower and higher wavenumber regions. At Reynolds numbers lower than the critical value, the nonlinear neutral surfaces form closed loops. by reducing the Reynolds number, we found that the nonlinear critical point occurs at a Reynolds number of 511.3, below which all the 2D disturbances will decay.
Author (AIAA)
Boundary Layers; Reattached Flow; Two Dimensional Flow

19980055618

Transition and turbulence modeling of low pressure turbine flows

Huang, P. G., Kentucky, Univ., Lexington, USA; Xiong, G., Kentucky, Univ., Lexington; Jan. 1998; In English
Contract(s)/Grant(s): NAG3-2018; NCC3-590
Report No.(s): AIAA Paper 98-0339; Copyright; Avail: Aeroplus Dispatch

This paper presents a laminar-turbulent interaction approach to model transitional flows over a modern turbine blade. The approach mainly addresses the issues of Reynolds number and freestream turbulence effects of the flows. The main feature of the approach is to incorporate the concept of intermittency of the transitional flows into current computational procedure using advanced turbulence models. The proposed approach was successfully validated against a range of Reynolds numbers and two freestream turbulence intensities. Comprehensive comparisons were made between numerical predictions and experimental data, including surface pressure distributions, boundary layer development through separation and transition zones, and detailed velocity and turbulence profiles. Results obtained from this study can help explain the complex interplay between the transition phenomena and the flow separation under the combined effects of the Reynolds number and the freestream turbulence intensity in the turbine flows.
Author (AIAA)
Transition Flow; Turbulent Flow; Low Pressure; Turbine Blades; Reynolds Number; Turbulence Effects; Free Flow

19980055635

Skin-friction reduction through micro blowing

Lin, Y.-L., Carnegie Mellon Univ., USA; Chyu, M. K., Carnegie Mellon Univ., USA; Shih, T. I.-P., Carnegie Mellon Univ., USA; Willis, B. P., NASA Lewis Research Center, USA; Hwang, D. P., NASA Lewis Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NSF CTS-97-00552; NAG3-1994
Report No.(s): AIAA Paper 98-0359; Copyright; Avail: Aeroplus Dispatch

Computations were performed to investigate a subsonic boundary-layer flow (0.7 freestream Mach number) on a flat plate with minute amounts of blowing from four rows of 'micro' holes arranged in a staggered fashion, in which the hole diameter is 1/65.5 the boundary-layer thickness. Results are obtained for the 3D flow and heat transfer above the plate and in the micro holes for three mass flux ratios (0, 0.0015, 0.015) and for adiabatic and isothermal wall conditions on the plate surface. The focus is on understanding how micro blowing affects skin friction and surface heat transfer. This computational study is based on the ensemble-averaged conservation equations of mass, momentum (compressible Navier-Stokes), and energy closed by a low-Reynolds number k-omega/SST turbulence model. Solutions were generated by a cell-centered finite-volume method that uses second-order accurate flux-difference splitting of Roe (1981, 1986), multigrid acceleration of a diagonalized ADI scheme with local time stepping, and patched/overlapped structured grids.
Author (AIAA)
Skin Friction; Blowing; Friction Reduction; Heat Transfer; Computational Fluid Dynamics

19980055639

Numerical analysis of Wells turbine aerodynamics

Watterson, J. K., Belfast, Queen's Univ., UK; Raghunathan, S., Belfast, Queen's Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0363; Copyright; Avail: Aeroplus Dispatch

This paper summarizes a numerical study of Wells turbine performance and aerodynamics using a modern 3D CFD method, and makes recommendations about the use of CFD for Wells turbine studies. Calculations have been performed for a monoplane

turbine comprised of straight NACA0015 blades at a stagger angle of 90 deg under the conditions: Reynolds number 8 x 10 exp 5 tip, Mach number 0.4, and hub to tip ratio 0.6. Flow coefficient, tip clearance, and blade number were varied in the calculations. The predictions agree favorably with experimental data, and the discrepancies can be explained partly by geometric differences between the experimental and numerical turbines. Because of the 90-deg stagger angle of the turbine, accurate predictions require fine resolution of the blade leading edge region. This makes calculations expensive, and it is recommended that CFD be used only when simpler predictive methods are not appropriate, e.g., to study the effect of hub or tip treatment on turbine aerodynamics.
Author (AIAA)
Airfoil Profiles; Turbine Blades; Aerodynamic Characteristics; Computational Grids; Monoplanes; Waterwave Energy Conversion

19980055646
Unsteady Euler computations through non-matching and sliding-zone interfaces
Eliasson, P., FFA, Sweden; Wang, D., FFA, Sweden; Meijer, S., FFA, Sweden; Nordstroem, J., FFA, Sweden; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0371; Copyright; Avail: Aeroplus Dispatch

The paper presents unsteady Euler computations through nonmatching and sliding-zone patched interfaces for 3D problems. An interpolation scheme is devised at the interface which interpolates the flow variables regardless of the local grid topology. to reduce the computational overhead, an efficient search algorithm is constructed to find the interpolation weights. It is demonstrated numerically that the second-order accuracy of the scheme is maintained despite the introduction of the interfaces. Numerical results for a propeller and a propeller-wing combination are finally presented.
Author (AIAA)
Unsteady Aerodynamics; Euler Equations of Motion; Propeller Noise; Noise Reduction; Computational Grids; Cross Flow

19980055654
Unstructured 3D-Euler computations for missiles at supersonic speeds and high angles of attack
Oktay, E., Roketsan Missile Industries, Turkey; Alemdaroglu, N., Roketsan Missile Industries, Turkey; Tarhan, E., Roketsan Missile Industries, Turkey; Champigny, P., ONERA, France; d'Espiney, P., ONERA, France; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0392; Copyright; Avail: Aeroplus Dispatch

This paper validates an inviscid 3D Euler flow solver, USER3D, against the experimental data and compares it with the FLU3M Euler solver of ONERA on two different missile geometries at a Mach number of 2 and at various angles of attack (0-20 deg). The first geometry is a conventional missile with an ogive nose, a cylindrical body, and four straight tail fins. The second geometry is a nonconventional missile with a lenticular body and no tail fins. The present results are found to be in good agreement with these available results, and the discrepancies observed between them are explained in detail. The present unstructured Euler code proved to be accurate, fast, and reliable for the aerodynamic design of conventional and nonconventional missiles.
Author (AIAA)
Missile Configurations; Supersonic Speed; Computational Grids; Three Dimensional Flow

19980055655
Direct calculation of aerodynamic force derivatives - A sensitivity-equation approach
Godfrey, Andrew G., AeroSoft, Inc., USA; Cliff, Eugene M., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Contract(s)/Grant(s): F49620-96-0329; NAS1-97061
Report No.(s): AIAA Paper 98-0393; Copyright; Avail: Aeroplus Dispatch

This work investigates the sensitivity-equation approach to computing stability derivatives using a single nonlinear solution to the Navier-Stokes equations. The sensitivity equations are presented in integral form with the necessary boundary conditions. Flow computations are presented for a flat plate boundary layer for validation. The lift-curve slope is computed at several angles of attack for a laminar airfoil. Stability characteristics are analyzed for the YB-49 flying wing.
Author (AIAA)
Aerodynamic Forces; Stability Derivatives; Nonlinear Equations; Airfoil Profiles; Boundary Layer Flow

19980055656
Computational prediction of pitch damping for high Mach number blunt projectiles
Ludlow, D. K., Cranfield Univ., UK; Qin, N., Cranfield Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0394; Copyright; Avail: Aeroplus Dispatch

A full 3D finite-volume Navier-Stokes solution methodology is presented for the prediction of individual and combined pitch damping coefficients for projectiles with inviscid subsonic regions, such as blunt-nosed geometries. Coning and helical motions are imposed on the projectile, and the governing 3D Navier-Stokes equations are transformed into a noninertial rotating frame of reference in which the flow field is potentially steady. The numerical scheme used to solve the governing equations in the noninertial framework is based on a high-resolution approximate Riemann solver. This method provides crisp capturing of the shock wave together with accurate predictions of viscous effects. The predicted pitch damping coefficient sum is compared with experimental wind tunnel measurements. For an efficient solution of the overall problem, a zonal approach is also presented, where the 3D noninertial solution around the nose is combined with a more efficient PNS noninertial solution downstream in the supersonic region for the pitch-damping prediction.
Author (AIAA)
Blunt Bodies; Pitching Moments; Projectiles; Finite Volume Method; Vibration Damping

19980055657
Prediction of pitch-damping of projectiles at low supersonic and transonic velocities
Weinacht, P., U.S. Army, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0395; Copyright; Avail: Aeroplus Dispatch
A computational approach for predicting the pitch-damping coefficient sum for axisymmetric projectiles at high subsonic, transonic, and supersonic velocities is presented. The technique makes use of a specific combination of coning and spinning motions that allows the pitch-damping force and moment coefficients to be determined from the aerodynamic side force and moment. A key feature of the approach is that steady flow fields are produced by the selected motions. A time-marching thin-layer Navier-Stokes approach is applied to compute the steady-state aerodynamic forces and moments resulting from the imposed coning and spinning motions. The technique is validated using data obtained from aerodynamics range firings of an ogive-cylinder configuration, and excellent agreement is found. Comparisons are also made with previously published parabolized Navier-Stokes computations at supersonic velocities.
Author (AIAA)
Projectiles; Pitching Moments; Transonic Flow; Vibration Damping; Supersonic Flow

19980055666
Prediction of wing flows with separation
Besnard, Eric, California State Univ., Long Beach, USA; Vermeersch, Thomas, California State Univ., Long Beach; Reboul, Guilhem, California State Univ., Long Beach; Schmitz, Adeline, California State Univ., Long Beach; Cebeci, Tuncer, California State Univ., Long Beach; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0404; Copyright; Avail: Aeroplus Dispatch
An efficient and accurate calculation method for the prediction of 3D flows with large regions of separation is described. The method is based on a stability/transition interactive boundary layer approach employing an extension to 3D flows of the modified Cebeci-Smith turbulence model. The method is first apphed to the calculation of the flow field about wings at low Reynolds numbers where the transition location is calculated within the 3D separation bubble. The method is then applied to 3D flows at higher Reynolds numbers and the boundary layer parameters are compared with experimental data. Results show good agreement with data and demonstrate the importance of calculating the onset of transition location. The method is also applied to the calculation of wing lift coefficients up to stall. Results demonstrate the ability of the method to predict 3D separated flows reliably, including near-stall conditions, showing the potential of the method as a practical and efficient design tool for high lift applications.
Author (AIAA)
Separated Flow; Three Dimensional Flow; Computational Fluid Dynamics; Airfoil Profiles; Aerodynamic Stalling

19980055667
Large eddy simulation if separated transonic flow around a wing section
Held, Jorgen, Lund Inst. of Technology, Sweden; Fuchs, Laszlo, Lund Inst. of Technology, Sweden; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0405; Copyright; Avail: Aeroplus Dispatch
Large eddy simulations of separated transonic flow around a NACA 0012 wing section are investigated. A dynamic subgrid scale model admitting anisotropic turbulent viscosity and an implicit model, where the subgrid scale effect is implicitly modelled through the numerical truncation error terms, are employed. The simulations are carried out for different Reynolds numbers ranging from 1 x 10 exp 5 to 5 x 10 exp 5 on two different computational grids. The angle of attack is 2.26 deg, and the Mach number 0.799. This flow is difficult to model since the laminar boundary layer first separates (shock-induced), reattaches, and thereafter undergoes transition so that further downstream it becomes a separated turbulent boundary layer. Predictions for pressure distribu-

tions and skin friction coefficients are reported. The computed pressure distribution and the location of the shock is compared with experimental data obtained at a Reynolds number of 3 x 10 exp 6.
Author (AIAA)
Large Eddy Simulation; Transonic Flow; Separated Flow; Wing Profiles; Viscous Flow; Turbulent Flow

19980055669

Experimentai investigation of a 40 percent thick half-span boundary layer control wing

Witte, Gerhard R., Purdue Univ., USA; Sullivan, John P., Purdue Univ., USA; Merchant, Ali, MIT, USA; Drela, Mark, MIT, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0407; Copyright; Avail: Aeroplus Dispatch

A new design for a low-speed boundary layer control airfoil is examined experimentally. A half-span wing model with this airfoil section has been designed and built employing an improved suction duct and suction manifold. Wake surveys are performed downstream of the model. A previously developed control volume analysis allows the evaluation of the conservation equations for a wing with suction and blowing, giving expressions for the forces on the wing as functions of wake quantities. The drag breakdown is then calculated from experimental data.
Author (AIAA)
Boundary Layer Control; Wing Profiles; Airfoil Profiles; Wakes; Flow Distribution

19980055671

Aerodynamic characteristics of a canard-controlled missile with a free-spinning tail

Auman, Lamar M., U.S. Army, Aviation and Missile Command, USA; Kreeger, Richard E., U.S. Army, Aviation and Missile Command, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0410; Copyright; Avail: Aeroplus Dispatch

A study was conducted to compare the aerodynamic characteristics of a canard-controlled missile with a free-spinning tail to that of an equivalent fixed-tail configuration. Data acquired during this test series indicate the static stability and pitch control authority of the baseline free-spinning tail configuration match that of the baseline fixed-tail configuration. The free-spinning tail eliminates roll coupling and reduces other out-of-plane forces and moments.
Author (AIAA)
Aerodynamic Characteristics; Canard Configurations; Missile Control; Wind Tunnel Models

19980055672

Numerical simulations of unsteady low-Reynolds-number flows over the APEX airfoil

Tatineni, Mahidhar, California, Univ., Los Angeles, USA; Zhong, Xiaolin, California, Univ., Los Angeles; Jan. 1998; In English
Contract(s)/Grant(s): NCC2-374
Report No.(s): AIAA Paper 98-0412; Copyright; Avail: Aeroplus Dispatch

Laminar and transitional separation bubbles are an important feature of low-Reynolds-number flows over airfoils. The separation bubbles are unsteady and have a significant impact on the aerodynamic properties of the airfoils. In this paper, unsteady low-Reynolds number separated flows over the APEX airfoil are calculated using a Navier-Stokes solver. The numerical resuits show the presence of unsteady separation bubbles in the flowfield. An analysis of the numerical results shows that flowfield disturbances are amplified significantly in the separation bubble, leading to periodic vortex shedding. A linear stability analysis of the separated boundary layer is performed, and the results show that the dominant wavenumber and frequency in the numerical simulations agree with the most unstable wavenumber and frequency from the linear stability analysis. The numerical results also show the growth and interaction of disturbance waves in the separation bubble. For transonic flows over the APEX airfoil, the calculations show that the presence of shocks causes significant changes in the separation location and, consequently, the overall flowfield.
Author (AIAA)
Digital Simulation; Unsteady Flow; Low Reynolds Number; Airfoil Profiles; Laminar Flow; Boundary Layer Separation

19980055673

Influence of cavity aperture and telescope shape on acoustics and unsteady flow of the SOFIA

Srinivasan, G. R., NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0413; Copyright; Avail: Aeroplus Dispatch

The Stratospheric Observatory For Infrared Astronomy (SOFIA) is a 2.5-meter aperture Cassegrain telescope housed in an open cavity aboard a Boeing 747-SP aircraft cruising around 13 km altitude. The open cavity of this airborne observatory presents some challenging aerodynamic and aeroacoustic issues that are being resolved for its design using results from computational and experimental investigations. The present study reports results from one such Navier-Stokes computational investigation on an overset grid system at wind tunnel and full configuration cruise flight conditions. Numerical results of time-averaged surface pressures for the empennage, spectra of unsteady pressures on bulkheads, and sound pressure levels on the telescope and bulkheads show fair comparisons with experiments. Results show a 440 Hz frequency as a dominant noise source for this cavity that agree with experimental observation. Determination of the aircraft drag shows a 2 percent increase in drag due to the open cavity. Finally, the open cavity condition is found to have negligible effect on the effectiveness of aircraft controls.
Author (AIAA)
Sofia (Airborne Observatory); Apertures; Cavities; Unsteady Flow; Reflecting Telescopes; Aeroacoustics

19980055674
Dynamic stall of pitching airfoils and slender wings - Similarities and differences
Ericsson, Lars E., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0414; Copyright; Avail: Aeroplus Dispatch

High performance aerospace vehicles that operate at high angles of attack are subject to unsteady separated flow fields that generate highly nonlinear aerodynamics. Experimental dynamic stall characteristics for wings with straight and highly swept leading edges are analyzed to provide insight into the underlying flow physics.
Author (AIAA)
Aerodynamic Stalling; Pitching Moments; Slender Wings; Airfoil Profiles; Unsteady Flow; Delta Wings

19980055675
Effect of reduced frequency on super maneuver delta wing
Abdelhamid, Yahia A., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-648
Report No.(s): AIAA Paper 98-0415; Copyright; Avail: Aeroplus Dispatch

The unsteady 3D, Reynolds-averaged Navier Stokes equations (NS) are used to simulate and study the flow response around a delta wing undergoing a pitch-up motion up to 90 deg amplitude. The governing equations are solved time-accurately using the upwind Roe flux-difference splitting, finite-volume scheme. The primary model under consideration consists of a 76-deg swept sharp-edged delta wing of zero thickness. The Reynolds number and Mach number are 0.45 x 10 and 0.3, respectively. The wing is forced to pitch-up through a ramp function, using a wide range of reduced frequency to provide a good understanding of reduced frequency effect on high amplitude pitch maneuvers. Three reduced frequency values of 0.834, 0.134, and 0.04. are used. The computed results are compared with each other as well as the existing experimental data.
Author (AIAA)
Delta Wings; Pitching Moments; Unsteady Flow; Three Dimensional Flow; Navier-Stokes Equation; Computational Fluid Dynamics

19980055676
An investigation of unsteady vortex flow for a pitching-rolling 70-deg delta wing
Kowal, H. J., Royal Military College of Canada, Kingston, Canada; Vakili, A. D., Tennessee, Univ., Tullahoma; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0416; Copyright; Avail: Aeroplus Dispatch

An investigation of vortex breakdown using quantitative flow visualization was conducted in the Royal Military College (RMC) of Canada water tunnel using a 70-deg delta wing under varying steady and unsteady conditions and combinations of pitch and roll oscillatory motion. All unsteady analyses were conducted at four distinct values of reduced frequencies. The steady state coupling effect of pitch and roll was an apparent superposition of the individual effects. For all unsteady motions, a hysteresis effect and a phase lag existed that increased with reduced frequency. The unsteady coupling effect of pitch and roll for the right wing was a reduction in hysteresis and, for the left wing, was an increase in hysteresis. For both sides of the wing though, there was an apparent superposition of the phase lag. For pure pitching and rolling motion, there was a notable increase in phase lag when the delta wing transitioned from the downstroke to the upstroke as compared to the transition from the upstroke to the down-

stroke. Observations also showed that the unsteady behavior of the vortex core angle as a function of angle of attack was independent of reduced pitch frequency.
Author (AIAA)
Unsteady Flow; Vortex Breakdown; Pitching Moments; Rolling Moments; Flow Visualization; Delta Wings

19980055677
An analytic model for control surface buzz
Nixon, David, NWING, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0417; Copyright; Avail: Aeroplus Dispatch

One of the recurring problems in the design of aircraft operating in the transonic regime is control-surface buzz. Buzz problems can range from the catastrophic, to the more benign problem of pilot discomfort. Buzz may be related to buffet, an increasingly important problem for advanced supercritical wings. Existing remedies for buffet and buzz are not universal and exact a weight penalty on the design. Recently, the buzz of a flaperon arose in a test for a mildly swept wing that differed only slightly from one in which buzz did not appear, suggesting that the phenomenon is very dependent on the geometry of the wing. Attempts to eliminate the buzz included the addition of vortex generators, the addition of wedges, (or spoiler), on and ahead of the flaperon, and using a wedge at the trailing edge. The wedge was the most successful of these strategies and works by fixing the shock ahead of the control. However, it can be argued that any strategy that alters the shock location or its strength at a particular flight condition, is simply avoiding buzz at that flight condition and not necessarily over the practical range of flight conditons.
Author (AIAA)
Noise Reduction; Aircraft Noise; Supersonic Aircraft; Control Surfaces

19980055678
Unsteady pressures on a blunt trailing edge - End plate and boundary layer effects
Vassilopoulos, Kaliope, Univ. College, Australia; Gai, Sudhir L., Univ. College, Australia; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0418; Copyright; Avail: Aeroplus Dispatch

Unsteady pressure measurements in the near wake of a blunt trailing edge airfoil were undertaken to investigate the effect of end constraints and the state of the separating boundary layer on the shedding vortex street. Fourier analysis of single-axis hot wire measurements and fluctuating pressure signals shows that while wall effects dominate the flow across the entire span with a laminar boundary layer, in the case of a turbulent separating boundary layer the wall influence is less. Also, the state of the boundary layer had a dramatic impact on both the fluctuating pressure signals and the shedding frequencies recorded. by inducing a turbulent boundary layer, the region of nominally 2D flow could be more than doubled, and possibly the two-dimensionality of the flow improved. With a turbulent boundary layer, there was a marked increase in not only the magnitude of the fluctuating pressure signals, but also the number of discrete shedding frequencies recorded. This could be attributed to shear layer instabilities which are stronger with a turbulent boundary layer. From these results, it would appear that the seemingly increased two-dimensionality of the flow with a turbulent boundary layer and end plates could lend itself to parallel vortex shedding, while oblique shedding is the more likely state with a laminar boundary layer in the absence of end constraints.
Author (AIAA)
Pressure Oscillations; Blunt Bodies; Trailing Edges; Airfoil Profiles; Vortex Shedding; Boundary Layer Separation

19980055679
Numerical simulation of dynamic stall using upwind methods and RNG turbulence models
Niu, Yang-Yao, Chung Hua Univ., Taiwan, Province of China; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0419; Copyright; Avail: Aeroplus Dispatch

A study of hybrid upwind schemes with the renormalization group theory (RNG) turbulence models for the calculations of dynamic stall is continued. In the approximation of the inviscid terms, a wave-particle split form added in the recent AUSMD flux-splitting scheme is shown to remove pressure oscillations in the downstroke modes of an oscillating airfoil and shows better accuracy than the original version. Meanwhile, excessive numerical dissipation effects in the van Leer splitting can be reduced by the use of the velocity splitting of the AUSMD/V. In the evaluation of the RNG turbulence models, the algebraic model associated with a damping dissipation rate demonstrates better accuracy than the RNG Q4 and k-epsilon models in the aerodynamic analysis of static and dynamic airfoil problems. In order to preserve the unsteady time accuracy, a dual time step integration is used.
Author (AIAA)
Digital Simulation; Aerodynamic Stalling; Upwind Schemes (Mathematics); Renormalization Group Methods; K-Epsilon Turbulence Model

19980055680

Turbulence structure of the flow downstream of a compressor cascade with tip leakage

Muthanna, Chittiappa, Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Wittmer, Kenneth S., Virginia Polytechnic Inst. and State Univ., Blacksburg; Devenport, William J., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English

Contract(s)/Grant(s): NAG1-1801

Report No.(s): AIAA Paper 98-0420; Copyright; Avail: Aeroplus Dispatch

Detailed measurements of the mean flow and turbulence stress field downstream of a linear compressor with tip gap have been made. The cascade, consisting of 8 GE Rotor B section blades, produces a highly periodic flow with 11.5 deg of flow turning. Measurements were made for an approach freestream velocity of 87 ft/s. The tip-leakage vortex dominates the endwall flow region. Away from the endwall, the blade wakes exhibit characteristics similar to those of a 2D wake. The mean flow fields of the blade wakes and vortex decay at similar rates as the flow travels downstream. The turbulence stress field of the wake decays at a rate consistent with the rate of decay of its mean flow field, but the decay rate of the turbulence generated by the vortex is much slower. The vortex generates intense turbulent fluctuations in an arch-shaped region surrounding the core that includes the region where flow is being lifted away from the endwall. This turbulence is apparently generated by the gradients of streamwise velocity associated with the vortex, rather than its circulating motion.

Author (AIAA)

Cascade Flow; Turbulent Flow; Compressors; Blade Tips; Wakes; Two Dimensional Flow

19980055681

Development of a Chimera unsteady method for the numerical simulation of rotorcraft flowfields

Boniface, J.-Ch., ONERA, France; Guillen, Ph., ONERA, France; Le Pape, M.-C., ONERA, France; Darracq, D., ONERA, France; Beaumier, Ph., ONERA, France; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0421; Copyright; Avail: Aeroplus Dispatch

We present some recent efforts worked out at ONERA to introduce a new Chimera unsteady technique for rotorcraft applications as an alternative approach to the moving distorted grid technique already developed for multibladed rotors in forward flight. A first set of code-to-code validation results, including a rotor-fuselage interaction configuration, is presented.

Author (AIAA)

Digital Simulation; Unsteady Flow; Rotary Wings; Computational Fluid Dynamics

19980055682

An experimental study of interactive behaviors between vectoring jet and main flows

Deng, Xue-ying, Beijing Univ. of Aeronautics and Astronautics, China; Wang, Yan-kui, Beijing Univ. of Aeronautics and Astronautics, China; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0422; Copyright; Avail: Aeroplus Dispatch

A low speed experimental study of interaction flows between vectoring jet and main flow around a typical advanced fighter configuration with double delta wing and elliptic body is presented. The experimental results show that the vectoring jet effects on the interaction flow are mainly divided into three types which are dependent of main flow patterns. In the attached main flows, the jet effects are limited in the flow area near the nozzle exit; in the stable leading edge vortex flows, the jet effects are weak on the vortices; in the burst vortex flows, the jet effects can recover the stable state to some extent. In order to get a favorable vectoring jet effect, it is important that wing configuration and exhaust nozzle arrangements should be carefully coupled.

Author (AIAA)

Interactional Aerodynamics; Jet Flow; Fighter Aircraft; Aircraft Configurations; Delta Wings; Leading Edges

19980055683

Unsteady 3-D incompressible flow interaction in multiple blade-row turbomachinery

Busby, Judy A., United Technologies Research Center, USA; Taylor, Lafe K., NSF Engineering Research Center; Mississippi State Univ., Mississippi State; Jiang, Minyee, NSF Engineering Research Center; Mississippi State Univ., Mississippi State; Whitfield, David L., NSF Engineering Research Center; Mississippi State Univ., Mississippi State; Jan. 1998; In English

Contract(s)/Grant(s): N00014-92-J-1060

Report No.(s): AIAA Paper 98-0423; Copyright; Avail: Aeroplus Dispatch

Marine propulsors operate in an inherently unsteady flowfield. to design a propulsor that meets the conditions imposed by hydrodynamic and hydroacoustic requirements, knowledge of component interactions and unsteady flow patterns throughout the propulsor is essential. The effect of the unsteady flow on the performance of the propulsor is not thoroughly understood; we use

CFD, coupled with measurements and analytic methods, to provide some insight into the physics associated with unsteady propulsor flows. The unsteady, incompressible Reynolds-Averaged Navier Stokes code has been extended for use in analyzing the unsteady flow interaction between blade rows in relative motion. The algorithm is used to compute the unsteady flow through a 3D, high Reynolds number pump consisting of 13 stator blades and 7 rotor blades. An analysis of the steady and unsteady flow effects is presented along with an investigation of the effects of subiterations on the time-accuracy on the solution. The unsteady interaction between the blade rows is apparent in both the stator and rotor blade rows. The computations verify that the potential flow interaction leads to unsteady pressures on the stators, and the wake interaction leads to unsteady loadings on the rotor.
Author (AIAA)
Unsteady Flow; Three Dimensional Flow; Incompressible Flow; Turbomachinery; Interactional Aerodynamics; Turbine Blades

19980055684

Parameters affecting penetration of a single jet into a supersonic crossflow - A CFD study. II

Roger, R. P., Johns Hopkins Univ., APL, USA; Chan, S. C., SY Technology, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0425; Copyright; Avail: Aeroplus Dispatch

Steady-state CFD analyses are performed for the 3D configuration of a single jet of square cross-section, exiting into a supersonic cross flow on a flat plate. The study is conducted to investigate the influence of jet Mach number, Mj, and approach boundary layer thickness, on the vertical penetration distance of the jet. The objective is to compare the percent change in jet penetration height with changes in Mj to previously developed empirical correlations. The influence of the jet to freestream momentum flux ratio as a pertinent scaling parameter for the jet penetration height is investigated. For fixed jet total conditions and mass flow rate, the predictions show, for jets with plumes that penetrate out from the approach boundary layer, an increase in jet penetration with jet Mach number from 1.0 to 3.0. For jets with plumes of the same order of magnitude as the boundary layer thickness, jet penetration increases with thickness of boundary layer, essentially independent of Mach number.
Author (AIAA)
Cross Flow; Supersonic Jet Flow; Computational Fluid Dynamics; Three Dimensional Flow; Interactional Aerodynamics; Boundary Layer Flow

19980055685

Low-order methods for two dimensional bluff bodies in ground effect

Tyll, J. S., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Schetz, J. A., Virginia Polytechnic Inst. and State Univ., Blacksburg; Mook, D. T., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0426; Copyright; Avail: Aeroplus Dispatch

The problem of flow over bluff bodies in ground effect is a difficult one which involves nonlinear aerodynamics and consequently expensive solution methods. The work presented here deals with the use of low-order aerodynamic computations to solve for these flows and capture the correct flow physics. The method proposed is capable of generating solutions which are comparable to those of higher-order methods and actual experiments. The ’lift reversal’ phenomenon is captured, and quantitative aerodynamic characteristics are obtained. It is also shown that the choice of panel method singularities is crucial to the calculation of flow over bodies in strong ground effect.
Author (AIAA)
Two Dimensional Bodies; Bluff Bodies; Ground Effect (Aerodynamics); Incompressible Flow; Skin Friction

19980055689

The compressible shear layer over a two-dimensional cavity

Murray, Robert, Rutgers Univ., USA; Elliott, Gregory S., Rutgers Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0430; Copyright; Avail: Aeroplus Dispatch

Single and double-pulsed planar laser Mie scattering from condensed ethanol particles was used to visualize the compressible shear layer over a closed cavity at Mach numbers of 1.8, 2.0, 2.7, and 3.5. Spatial correlations based on large ensembles of the resultant images were used to track structures in the shear layer above the cavity, and thus quantify convective velocities and structure size, shape, and orientation. Structures were found to be significantly smaller and less organized at higher Mach numbers. The structures were oriented more nearly parallel to the flow at higher Mach numbers.
Author (AIAA)
Compressible Flow; Shear Layers; Cavity Flow; Aerodynamic Configurations; Supersonic Flow; Flow Visualization

19980055691

Survey of flight data for boundary-layer transition at hypersonic and supersonic speeds

Schneider, Steven P., Purdue Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0432; Copyright; Avail: Aeroplus Dispatch

Published flight data for boundary-layer transition at hypersonic speeds is surveyed. The survey is limited to measurements reported in the open literature and carried out at hypersonic and high-supersonic speeds, on vehicles for which ablation is believed to be negligible or small. The purpose is to catalog work that may be suitable for validation of flow-physics models and advanced transition-estimation methods such as e exp N. Brief discussions are presented for each report. Known e exp N comparisons are also presented.

Author (AIAA)

Hypersonic Flight; Flight Characteristics; Boundary Layer Transition; Supersonic Flow; X-33 Reusable Launch Vehicle; Flow Stability

19980055692

Hypersonic boundary-layer stability over blunt leading edges with bow-shock effects

Hu, Sean, California, Univ., Los Angeles, USA; Zhong, Xiaolin, California, Univ., Los Angeles; Jan. 1998; In English

Contract(s)/Grant(s): F49620-97-1-0030; F49620-95-1-0405

Report No.(s): AIAA Paper 98-0433; Copyright; Avail: Aeroplus Dispatch

The stability of the hypersonic flow over a parabolic leading edge is numerically investigated using linear stability analysis accounting for the existence of shock waves in comparison with direct numerical simulations. The linear stability analysis is performed using a global spectral collocation method accounting for the shock effects by using Rankine-Hugoniot shock conditions on the upper boundary. The stability characteristics of the shock modes and the boundary layer modes are investigated. It is found that the shock modes and the first modes have rapid changes in their amplification rates when their wavenumbers cross. The effects of the Reynolds number are also investigated. Second and higher modes are found to be the dominant modes for the case of high Reynolds number.

Author (AIAA)

Leading Edges; Blunt Bodies; Hypersonic Boundary Layer; Boundary Layer Stability; Oblique Shock Waves; Rankine-Hugoniot Relation

19980055693

Traveling instabilities in elliptic cone boundary-layer transition at Mach 8

Poggie, J., USAF, Research Lab., USA; Kimmel, R. L., USAF, Research Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0435; Copyright; Avail: Aeroplus Dispatch

Traveling instability waves were observed preceding boundary-layer transition on an elliptic cone of 2:1 aspect ratio at a freestream Mach number of 8. Hot-film probe measurements and schlieren photographs were obtained under adiabatic wall conditions; heat transfer data and shadowgraphs were obtained for a cold-wall case. Evidence of the crossflow instability and the Mach second-mode instability was found. The transition front was asymmetric, with early transition near the top centerline and delayed transition near the leading edge.

Author (AIAA)

Traveling Waves; Mach Cones; Boundary Layer Transition; Hypersonic Flow; Aerodynamic Configurations

19980055694

Measurements of controlled wave packets at Mach 4 on a cone at angle of attack

Ladoon, D. W., Purdue Univ., USA; Schneider, S. P., Purdue Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): F49620-94-1-0067; F49620-97-1-0037

Report No.(s): AIAA Paper 98-0436; Copyright; Avail: Aeroplus Dispatch

An experimental study of wave-packet development on a sharp-nosed, 5-deg half-angle cone was conducted in a Mach 4, quiet-flow wind tunnel. The cone was pitched to a 3-deg angle of attack. Controlled and repeatable disturbances were created at the wall of the laminar boundary layer by a pulsed, point-source, glow discharge. Flow measurements were made along the leeward ray of the cone with a single-element, hot-wire probe. Boundary-layer traverses were made at three locations downstream of the glow to characterize the streamwise evolution of the wave packet. The peak wave amplitude occurred near the boundary-layer edge and in the region of maximum shear. The boundary-layer thickness at the furthest streamwise measurement station of x = 140 mm (Re(x) = 570,000) was about 5.6 mm. Weak but significant wave growth was observed. The convective speed of the

packet was on the order of 0.89 times the freestream velocity. Repeatability of the wave packet is 4.5 percent based on the peak rms amplitude.
Author (AIAA)
Wave Packets; Mach Cones; Angle of Attack; Wind Tunnel Tests; Laminar Boundary Layer; Flow Measurement

19980055699

Near wall vortex structures in an inclined cylinder wake

Shizawa, Takaaki, Tokyo, Science Univ., Japan; Honami, Shinji, Tokyo, Science Univ., Japan; Miyauchi, Kotaro, Mitsubishi Heavy Industries, Ltd., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0441; Copyright; Avail: Aeroplus Dispatch
This paper presents an experimental study focused on the behavior of a wake shed from an inclined circular cylinder. A cylinder with 30 mm in diameter and an aspect ratio of 7.6 is established on a flat wall where a 2D turbulent boundary layer is developed. Nine cases of inclined cylinder, inclined angle of +/- 30, +/- 20, +/- 15, +/- 10, and 0 deg are investigated. The reference velocity is 13 m/s, the boundary layer thickness is 16.7 mm, and the cylinder diameter Reynolds number is 2.5 x 10 exp 4. Wall static pressure is measured, and wall flow pattern is observed by using an oil film flow visualization technique. The characteristics of the flow field are investigated both by the smoke-wire method and hot-wire anemometry. Mean velocity, turbulence intensity, and shedding frequency are presented close to the cylinder. The vortex structure near the wall is classified into three patterns. The cross flow mainly determines the near-wall vortex structure in the case of the forward inclined cylinder. In the case of the backward inclined cylinder, the structure is identified by the penetration of the approaching freestream into the cylinder wake.
Author (AIAA)
Aircraft Wakes; Vortex Shedding; Turbulent Boundary Layer; Flow Visualization; Cross Flow; Flow Characteristics

19980055735

Physical mechanisms of glaze ice scallop formations on swept wings

Vargas, Mario, NASA Lewis Research Center, USA; Reshotko, Eli, Case Western Reserve Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0491; Copyright; Avail: Aeroplus Dispatch
Results of an experiment conducted to understand the physical mechanisms that lead to the formation of scallops on swept wings are presented. Icing runs were performed on a NACA 0012 swept wing tip at 45-, 30-, and 15-deg sweep angles. A baseline case was chosen, and direct measurements of scallop height and spacing, castings, video data, and close-up photographic data were obtained. It is shown the scallops are made of glaze ice feathers that grow from roughness elements that have reached a minimum height and are located beyond a given distance from the attachment line. This distance depends on tunnel conditions and sweep angle, and is the critical parameter in the formation of scallops. It determines if complete scallops, incomplete scallops, or no scallops are going to be formed. The mechanisms of growth for complete and incomplete scallops are identified. The effect of velocity, temperature, and cloud liquid water content on scallop formation is studied. The possibility that cross flow instability may be the physical mechanism that triggers the growth of roughness elements into glaze ice feathers is examined.
Author (AIAA)
Glazes; Swept Wings; Aircraft Icing; Scalloping; Wing Tips

19980055760

Airfoil geometry and flow compressibility effects on wings and blade flutter

Jones, K. D., U.S. Naval Postgraduate School, USA; Platzer, M. F., U.S. Naval Postgraduate School, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0517; Copyright; Avail: Aeroplus Dispatch
An unsteady, 2D incompressible potential-flow solver and an unsteady, 2D compressible Euler/Navier-Stokes flow solver are coupled with a two-degree-of-freedom structural model for the time-domain computation of aeroelastic response. Comparisons are made between results from the two flow solvers and with flutter boundary predictions of linear theory. Presented results demonstrate similar destabilizing effects for both increasing airfoil thickness and increasing Mach number. More importantly, it is shown that linear theory yields unconservative flutter-velocity predictions. While linear theory predicts that single degree-of-freedom (pitching) flutter cannot occur except with an unrealistically high sectional moment of inertia, it is shown here that thicker airfoils in compressible flows may easily achieve single degree-of-freedom flutter under realistic conditions.
Author (AIAA)
Airfoil Profiles; Compressible Flow; Wing Oscillations; Flutter; Unsteady Flow; Two Dimensional Flow

19980055766

Single block structured body fitted grid generation and flow solution method for complex geometries

Joo, Ick-Chan, Hyundai Space and Aircraft Co., Ltd., Republic of Korea; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0523; Copyright; Avail: Aeroplus Dispatch

A new method for calculating the flow about or through complex bodies is presented. This method is designed to reduce the total analysis time by combining the best, or time saving, features of the structured and unstructured approaches. Automated grid generation procedures are used to produce single structured block grids. Automation is achieved by transforming all geometries to the same topology, such as a sphere in 3D and a circle in 2D. This procedure is called topology conversion. A second procedure, called structure conversion, is used to make a single structured surface grid on the homotopic body. A conventional grid generation method is then applied to discretize tbe flow volume. The resulting grid is a single structured block and is body conformed. A fast structured flow solver is used to obtain solutions. Bi-plane configurations are used for 2D examples. A duct with NACA0012 cross section is used for a 3D example.

Author (AIAA)

Grid Generation (Mathematics); Flow Geometry; Computational Fluid Dynamics; Computer Aided Design

19980055767

Computational study of high-angle-of-attack missile flows using two-equation turbulence models

Josyula, Eswar, USAF, Research Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0525; Copyright; Avail: Aeroplus Dispatch

A numerical simulation is presented for the steady state flow over a missile body configuration for supersonic Mach number at incidence. The missile has a diameter, d, of 3.7 in. and a length of 13 d. Flow conditions specified are Mach 2.5, angle-of-attack of 14 deg, and a Reynolds number based on the diameter of the afterbody of 1.23 million to match experimental conditions. The 3D Navier-Stokes equations in mass-averaged form were numerically integrated using both central and upwind difference methods, and the implicit Beam and Warming algorithm with the two-equation k-epsilon turbulence model to provide closure of the system of equations. The upwind method captured the cross-flow shock better, and the central difference method predicted the vortex shape and strength better. Modifications to the two-equation turbulence model which limited the production of eddy viscosity for vortical flows were implemented to assess the improvement in accuracy. The modifications improved the prediction of the vortical shape and strength and showed improvements in the surface pressure predictions due to stronger primary and secondary vortices.

Author (AIAA)

Angle of Attack; Digital Simulation; Missile Configurations; Steady Flow; Supersonic Flow; Navier-Stokes Equation

19980055769

Transonic missile drag area-rule and afterbody-role verification with CFD

Biblarz, O., U.S. Naval Postgraduate School, USA; Pomerantz, B., U.S. Naval Postgraduate School, USA; Lindsey, S., U.S. Naval Postgraduate School, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0527; Copyright; Avail: Aeroplus Dispatch

In complex configurations, combining the area rule with CFD has the potential of saving attractive amounts of computer effort. When properly applied, the area rule could introduce substantial shortcuts toward minimum drag designs. We show that the average slope of the afterbody region (the region of decreasing cross-sectional area in the flow direction) correlates with the drag coefficient. The drag increases with the magnitude of this slope. When interference effects between components are present, the fine details of a missile afterbody region are subordinated and often get blurred by the boundary layers. Euler calculations are a sufficient relative indicator of minimum drag with Navier-Stokes calculations necessary only to refine the numbers.

Author (AIAA)

Computational Fluid Dynamics; Transonic Flight; Missile Configurations; Drag; Afterbodies; Navier-Stokes Equation

19980055770

Further investigation of control surface reversal in the transonic regime

Andersen, G., USAF, Research Lab., USA; Kolonay, R., USAF, Research Lab., USA; Eastep, F., Dayton, Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0529; Copyright; Avail: Aeroplus Dispatch

This paper investigates control surface reversal in the transonic flight regime. Linear and nonlinear rigid and aeroelastic analyses are performed while including the effects of flow viscosity with an interactive boundary layer in the prediction of this aeroelastic phenomenon. Transonic small disturbance theory is employed in the analysis of a typical fighter type wing to study the

interactions among control surface deflections, structural flexibility, and embedded shocks in a flow field where a viscous boundary layer exists. Pressure distributions on the wing are examined, and control surface reversal calculations are presented. These results are discussed based on the predictions of the pressure coefficients generated by the solution of the transonic small-disturbance equation. Generalizations are offered concerning the effects of including viscosity in the prediction of steady aeroelastic phenomena in the transonic flight regime. Finally, the consequences of these findings on the preliminary design of aircraft structures are discussed.
Author (AIAA)
Control Surfaces; Transonic Flight; Aeroelasticity; Structural Design; Aircraft Structures

19980055773

Receptivity of the Mach-4 boundary layer on an elliptic cone to laser-generated localized freestream perturbations

Schmisseur, J. D., USAF, Wright Lab., USA; Schneider, Steven P., Purdue Univ., USA; Collicott, Steven H., Purdue Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): F49620-94-1-0067; F49620-97-1-0037
Report No.(s): AIAA Paper 98-0532; Copyright; Avail: Aeroplus Dispatch

A repeatable, localized, laser-generated perturbation technique has been developed for application to supersonic and hypersonic boundary-layer receptivity experiments. The effect of the perturbation on the boundary layer on a 5-in. long, 4:1 elliptic cross-section cone has been examined in the Mach-4 Purdue Quiet-flow Ludwieg Tube at a freestream unit Reynolds number of 4.5 million/m. The perturbation is formed using the focused beam from a frequency-doubled Nd:YAG laser and exists in the flow field as a region of locally heated air called the thermal spot. The thermal spot convects downstream with the local velocity. Constant-temperature anemometer measurements have been used to characterize the perturbation, both in the freestream and on the elliptic cone. Supplemental cold-wire constant-current anemometry measurements on the cone have allowed calculation of the mass-flux profiles in the elliptic-cone boundary layer. The mass-flux profiles are inflected on the cone minor axis; the boundary layer thickness is about 5 min. The boundary-layer response to the thermal spot passage is largest and most complex near the boundary-layer edge.
Author (AIAA)
Boundary Layers; Laser Outputs; Perturbation Theory; Ellipticity; Cones; Free Flow

19980055774

Direct numerical simulation of 3-D hypersonic boundary layer receptivity to freestream disturbances

Zhong, Xiaolin, California, Univ., Los Angeles, USA; Jan. 1998; In English
Contract(s)/Grant(s): F49620-95-1-0405; F49620-97-1-0030
Report No.(s): AIAA Paper 98-0533; Copyright; Avail: Aeroplus Dispatch

In direct numerical simulation (DNS) of the receptivity to freestream disturbances and the laminar-turbulent transition process of hypersonic boundary layers, it is necessary to consider the effect of the interaction between the bow shocks and wave fields. In previous papers, we developed a fifth-order shockfitting numerical method and conducted the DNS of the generation of boundary layer instability waves due to freestream acoustic disturbances for a 2D Mach 15 flow over a parabolic leading edge. It was shown that instability waves developed in hypersonic boundary layers behind bow shocks contain both the first- and second-mode waves. The use of the high-order shock-fitting scheme makes it possible to accurately simulate physical bow-shock oscillations and interactions. This paper extends the previous 2D work to a 3D shock-fitting scheme for the DNS of 3D hypersonic flows over blunt cones of arbitrary cross sections and over blunt wedges. The new 3D shock-fitting scheme is then used to study the receptivity of both axisymmetric and 3D hypersonic boundary layers to freestream disturbances in Mach 15 flows over a parabolic cone and a parabolic wedge.
Author (AIAA)
Digital Simulation; Three Dimensional Boundary Layer; Hypersonic Boundary Layer; Free Flow; Boundary Layer Transition; Bow Waves

19980055777

Advanced turbulence models for high-Mach number wall bounded flows

Barber, T. J., United Technologies Research Center, USA; Choi, D., United Technologies Research Center, USA; Nedungadi, A., United Technologies Research Center, USA; Orszag, S. A., Cambridge Hydrodynamics, Inc., USA; Konstantinov, A., Cambridge Hydrodynamics, Inc., USA; Staroselsky, I., Cambridge Hydrodynamics, Inc., USA; Jan. 1998; In English
Contract(s)/Grant(s): F33615-95-C-2569
Report No.(s): AIAA Paper 98-0536; Copyright; Avail: Aeroplus Dispatch

Accurate prediction of the mixing and entrainment process in supersonic turbulent flows has been a challenging task for the turbulence modeling community. Supersonic propulsion systems depend on injection and burning of fuel in very high speed flow fields. Good mixing is essential for efficient combustion. Mixing is also important in understanding the acoustic characteristics of jets. The ability of various turbulence models to predict the mixing phenomenon is investigated in this paper. In addition, the effects of compressibility and temperature transport are considered. Two configurations are considered in this study: the reattachment of a free turbulent shear layer, and 3D compressible flow around a swept ramp fuel injector. Experimental data are available for both these flows, and the computed results are compared with the data.
Author (AIAA)
K-Epsilon Turbulence Model; Supersonic Flow; Turbulent Flow; Reattached Flow; Shear Layers; Compressible Flow

19980055783

Steady-state solution-adaptive Euler computations on structured grids

Dudek, Scott A., McDermott Technology, Inc., USA; Colella, Phillip, Lawrence Berkeley National Lab., USA; Jan. 1998; In English
Contract(s)/Grant(s): DE-AC03-76SF-00098
Report No.(s): AIAA Paper 98-0543; Copyright; Avail: Aeroplus Dispatch

A local solution-adaptive mesh refinement algorithm is used to produce steady-state flow results on structured grids for the 2D Euler equations. The solution is marched to steady state using an explicit, cell-centered, second-order unsplit multidimensional upwind method. Convergence is accelerated by local time stepping and a multigrid method. The flexibility and efficiency of the algorithm are shown by presenting three test cases, a variety of subsonic and transonic internal and external flows.
Author (AIAA)
Steady State; Steady Flow; Two Dimensional Flow; Euler Equations of Motion; Upwind Schemes (Mathematics)

19980055786

Application of a high-order reconstruction scheme to turbulent flow calculations using hybrid-Cartesian adaptive unstructured grids

Geuzaine, P., Liege, Univ., Belgium; Delanaye, M., NASA Ames Research Center, USA; Liu, Y., NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0546; Copyright; Avail: Aeroplus Dispatch

Hybrid-Cartesian grids are generated around complex airfoil geometries. These meshes are obtained by intersecting hyperbolic grids generated in boundary layers and wakes with a Cartesian grid covering the whole domain. The resulting mesh is considered as fully unstructured and made of general polygonal elements. A high-order accurate finite-volume scheme based on a quadratic polynomial approximation of the data in each control volume is employed. The Spalart-Allmaras turbulence model is implemented. Steady-state solutions are obtained by using a fully implicit scheme based on a Newton linearization and Krylov subspace techniques. The accuracy and efficiency of the whole procedure is demonstrated by computing several laminar and turbulent viscous flows around single and multi-element airfoils.
Author (AIAA)
Turbulent Flow; Computerized Simulation; Turbulence Models; Laminar Flow; Airfoil Profiles

19980055787

Design of a Mach-6 quiet-flow wind-tunnel nozzle using the eN method for transition estimation**

Schneider, Steven P., Purdue Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): F49620-97-1-0037
Report No.(s): AIAA Paper 98-0547; Copyright; Avail: Aeroplus Dispatch

A high Reynolds-number Mach-6 quiet-flow wind-tunnel nozzle has been designed for a new quiet-flow Ludwieg tube. The quiet-flow nozzle is designed to maintain laminar boundary layers on the nozzle walls as far downstream as possible. A very long nozzle with gentle curvature is used to reduce Goertler instability. Early transition would occur in adiabatic nozzles of this type, due to the first-mode TS instability. This is controlled with an isothermal wall temperature that is high near the throat and tapers to ambient near the exit. The crossflow instability is eliminated through use of an axisymmetric nozzle. Predictions using e exp N techniques suggest that a quiet-flow Reynolds number in excess of 13 million can be achieved in a 103-inch-long 9-inch-diameter prototype nozzle at 10 atm. total pressure. This performance would be about twice that of the existing Langley Mach-6 quiet-

flow nozzle. A 33-ft-long 24-inch nozzle at the same pressure is predicted to have a quiet Reynolds number of more than 36 million, a value sufficient to allow reproducing many flight experiments.
Author (AIAA)
Mach Number; Steady Flow; Wind Tunnel Nozzles; Laminar Boundary Layer; Boundary Layer Transition; Hypersonic Wind Tunnels

19980055814

Improved methodology for axial force prediction at angle of attack

Moore, F. G., U.S. Navy, Naval Surface Warfare Center, USA; Hymer, T. C., U.S. Navy, Naval Surface Warfare Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0579; Copyright; Avail: Aeroplus Dispatch

An improved semiempirical method for axial force calculation on missile configurations has been developed that uses (1) theoretical methods currently used in the Naval Surface Warfare Center Aeroprediction Code for zero angle-of-attack (alpha) axial force computations and (2) several wind tunnel data bases to compute changes in axial force at alpha. The method is applicable to bodies alone, wing-body, and wing-body-tall configurations for both zero and nonzero control deflections. It has been developed to allow computation for alpha to 90 deg at Mach numbers up to 20. However, it has been validated against data only to Mach number of 4.6 and alpha to 40 deg for all configurations. For body-alone and wing-body cases, it has been validated to 90 deg alpha. Additional test data or Navier Stokes computations would allow refinement of the improved method. The new method has been compared to several existing techniques. The method was found to be as good as or better than existing techniques, but more general than existing methods in terms of configurations and Mach numbers allowed for the method to be used.
Author (AIAA)
Angle of Attack; Axial Stress; Semiempirical Equations; Missile Configurations; Prediction Analysis Techniques

19980055815

Analysis of free-flight data for the CAN4 hypersonic research projectile

Dupuis, A. D., Defence Research Establishment Valcartier, Canada; Edwards, J. A., Defence Evaluation and Research Agency, UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0581; Copyright; Avail: Aeroplus Dispatch

Free flight tests were conducted in the Defense Research Establishment-Valcatier aeroballistic range on a cone-cylinder-flare configuration to study the aerodynamic characteristics. The projectiles were fired from a 110 mm smooth-bore gun at muzzle velocities ranging between 1650 m/sec (Mach 4.8) and 2150 m/sec (Mach 6.3). The projectiles were tested with and without a base cavity. All the main aerodynamic coefficients were determined, including the nonlinear cubic pitching moment term resulting in an accurate data base for CFD validation. Aerodynamic predictions from three semiempirical models were compared with the experimental data.
Author (AIAA)
Free Flight; Hypersonic Vehicles; Projectiles; Ballistic Ranges; Flight Tests; Aerodynamic Characteristics

19980055818

Skin friction distribution on a wingtip

Zilliac, Gregory G., NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0584; Copyright; Avail: Aeroplus Dispatch

The relatively new FISF technique has been used to accurately measure the skin friction distribution on a wing in the vicinity of the tip. The resolution of data taken was sufficient to permit a detailed examination of the surface shear stress behavior in this highly 3D flow field. A comparison of coefficient of friction measured on the wingtip with computed Reynolds-averaged Navier Stokes results showed large differences. This disagreement, which is thought to be a result of turbulence modeling deficiencies, serves to reaffirm the importance of skin friction measurements.
Author (AIAA)
Skin Friction; Wing Tips; Friction Measurement; Coefficient of Friction; Interferometry; Photogrammetry; Stress Distribution

19980055821

The effects of thin paint coatings on the aerodynamics of semi-span wings

Schairer, Edward T., NASA Ames Research Center, USA; Mehta, Rabindra D., NASA Ames Research Center, USA; Olsen, Michael E., NASA Ames Research Center, USA; Hand, Lawrence A., NASA Ames Research Center, USA; Bell, James H., NASA Ames Research Center, USA; Whittaker, Pat J., NASA Ames Research Center, USA; Morgan, Daniel G., NASA Ames Research

Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0587; Copyright; Avail: Aeroplus Dispatch

Recent experiences with pressure-sensitive paint (PSP) have shown that very thin paint layers on wind-tunnel models tested at high Reynolds numbers can significantly alter the pressure distributions, and thus the forces and moments, on the models. This was observed during two tests of transport-like wings: a 'clean' supercritical wing at transonic cruise conditions in the High Reynolds Number Channel 2, and a high-lift wing, complete with slats and flaps, at landing conditions in the 12-Ft Pressure Wind Tunnel. The effect of paint on the cruise wing was to displace the shock wave slightly upstream from its no-paint position. Smoothing the paint, and even removing it entirely from the leading edge, decreased this displacement slightly. Applying paint to only the slats of the high-lift wing caused the wing to stall prematurely at the highest Reynolds number. This effect could be eliminated by smoothing the paint. Adding paint to other parts of the model had little effect. Paint intrusiveness was much smaller and more ambiguous at lower Reynolds numbers. The roughness of the paint in both tests did not exceed generally accepted 'admissible roughness' criteria for turbulent boundary layers, nor did it exceed accepted criteria for forcing premature transition of a laminar boundary layer.

Author (AIAA)

Semispan Models; Wind Tunnel Models; Wind Tunnel Tests; Surface Roughness Effects; Thickness

19980055824

Experimental investigation of co-rotating trailing vortices

Jacob, J. D., Kentucky, Univ., Lexington, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0590; Copyright; Avail: Aeroplus Dispatch

The paper discusses preliminary results of experiments to generate a single pair of corotating trailing vortices and observe their behavior in a towing tank. Several configurations of lifting surfaces are used to achieve this. A laser sheet illuminates tracer particles in the flow and a digital camera is used to capture a sequence of PIV images. Planar velocity vector fields and their gradients are derived from these images using an adaptive Lagrangian parcel tracking algorithm. Isovorticity surfaces are extracted from time series of planar vorticity data. Reynolds numbers based on total circulation of the vortices in the present experiments range from 2.5 x 10 exp 3 to 1.0 x 10 exp 4. Merger of the corotating vortex pair is observed at all circulation Reynolds numbers. The relation between merger time and Reynolds number is neither constant nor monotonic however, differing from previous experiments at higher Reynolds numbers. Merger occurs from 1/4 to 1/3 of an orbit period for typical cases. The merger process appears to be inviscid and 3D. No evidence of breakdown or strong instabilities are present.

Author (AIAA)

Vortices; Particle Image Velocimetry; Corotation; Wakes

19980055826

Decay of wake vortices of large aircraft

Sarpkaya, Turgut, U.S. Naval Postgraduate School, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0592; Copyright; Avail: Aeroplus Dispatch

A brief summary of previous works is followed by an in-depth analysis of velocities, circulations, and decay histories of a number of trailing vortices generated by large aircraft during field tests in Memphis, TN. The results suggest that the decay of trailing vortices is governed by the mutual straining of vortices; intermittent exchange of mass, momentum, and vorticity across the core boundary; rotational damping and restructuring of turbulence in the core; stretching of large turbulent structures, turbulent diffusion, the interaction of oppositely-signed vorticity in the overlapping regions of the vortex pair; and the draining of vorticity from the Kelvin oval.

Author (AIAA)

Vortex Breakdown; Aircraft Wakes; Flight Tests

19980055828

Investigation of three-dimensional vortex-wake interaction with the ground

Adam, Ihab G., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0594; Copyright; Avail: Aeroplus Dispatch

A 3D computational study of vortex-wake flow with and without exhaust plume near the ground is carried out. The Navier-Stokes (NS) equations are solved using the implicit, upwind. Roe flux-differencing, finite volume scheme. The computations of vortex-wake interaction with the ground are carried out using overlapping zonal method for long distances downstream. Typical velocity profiles of a tip vortex with and without exhaust plume temperature profiles are used for inflow boundary conditions. The effects of the plume temperature on the vortex descent, boundary-layer separation and vortex rebound are studied and vali-

dated with the available experimental data. Moreover, the effect of the flow in the axial direction on the vortex descent is studied by using two different axial velocity profiles at the inlet boundaries.
Author (AIAA)
Ground Effect (Aerodynamics); Aircraft Wakes; Vortices; Three Dimensional Flow; Finite Volume Method; Computational Fluid Dynamics; Exhaust Flow Simulation

19980055829

Two numerical studies of trailing vortices

Shur, M., Federal Scientific Center 'Applied Chemistry', Russia; Strelets, M., Federal Scientific Center 'Applied Chemistry', Russia; Travin, A., Federal Scientific Center 'Applied Chemistry', Russia; Spalart, P. R., Boeing Commercial Airplane Group, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0595; Copyright; Avail: Aeroplus Dispatch
Two types of trailing-vortex flows are calculated on the basis of the Reynolds Averaged Navier-Stokes equations coupled with three turbulence models: the one-equation Spalart-Allmaras (SA) model, the SA model with a rotation/curvature correction, and the two-equation k-omega model of Menter (1993). The first flow type contains one or more vortex pairs in ground effect with side wind. The second type is the trailing-vortex system behind a generic civil aircraft model at high lift, for which we have experimental data of de Bruin et al. (1996). The major conclusion of the study performed is that the rotation/curvature correction proposed for the SA model actually provides much better predictions of both flows, by drastically reducing the diffusion of the vorticity.
Author (AIAA)
Vortices; Navier-Stokes Equation; Reynolds Averaging; Turbulence Models; Ground Effect (Aerodynamics)

19980055834

Power law leading edges for waveriders designed with shock attachment

O'Brien, Timothy F., Maryland, Univ., College Park, USA; Lewis, Mark J., Maryland, Univ., College Park; Jan. 1998; In English
Contract(s)/Grant(s): NAGW-11796
Report No.(s): AIAA Paper 98-0600; Copyright; Avail: Aeroplus Dispatch
The inviscid 2D flowfields over various power law-shaped leading edges were determined using both computational and analytical solutions. These leading edge shapes have both infinite body slope (characteristic of a blunt body) and zero radius of curvature (characteristic of a sharp body) at the nose. The aerodynamic performance of these shapes is compared to a corresponding circular cylinder leading edge shape (typically used in blunting sharp leading edges for heat transfer considerations). Power law leading edges are shown to have smaller shock standoff distance and lower wave drag than their corresponding circular cylinder shape. The shape of the shock wave in the subsonic region of the flowfield is seen to be well-approximated by a hyperbolic curve. It is suggested that such shapes may have application to the leading edges of practical hypersonic waverider designs; power law geometries may retain reasonable shock attachment with tolerable heat transfer characteristics.
Author (AIAA)
Leading Edges; Waveriders; Reattached Flow; Shock Waves; Hypersonic Aircraft

19980055837

Interaction of separating flows with a driven flexible surface

Sinha, S. K., Mississippi, Univ., University, USA; Wang, H., Mississippi, Univ., University; Pal, D., Mississippi, Univ., University; Jan. 1998; In English
Contract(s)/Grant(s): DAAH04-94-G-0268; DAAH04-93-G-0451
Report No.(s): AIAA Paper 98-0603; Copyright; Avail: Aeroplus Dispatch
A driven flexible surface has been used to control unsteady flow separation on a cylinder at Reynolds number of 1.5 x 10 exp 5. The separation control experiment has been carried out with and without a splitter plate to study the effect of low-frequency flow oscillations due to vortex-shedding. Passive and active motions of the flexible surface are found to affect the velocity fluctuations at the outer region of the boundary layer. Separation is controlled if the active wall perturbations lock on to the most amplified instability frequency of the separating shear layer.
Author (AIAA)
Boundary Layer Separation; Flexible Bodies; High Reynolds Number; Oscillating Flow; Boundary Layer Control

19980055838

Aerodynamic heating measurement on ceramic tile region of Hypersonic Flight Experiment (HYFLEX)

Fujii, Keisuke, National Aerospace Lab., Japan; Inoue, Yasutoshi, National Aerospace Lab., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0605; Copyright; Avail: Aeroplus Dispatch

Measured aerodynamic heating over the ceramic tile region of Hypersonic Flight Experiment (HYFLEX) Vehicle, launched in February 1996, was compared with results, where good agreement was present in terms of Stanton number ratio. Flight measurements also showed that boundary layer transition occurred on windward side and the position of transition moved forward to about 30 percent of x/L within several seconds. Local flow condition at which the transition was observed is evaluated with a criterion for attachment line transition of a yawed cylinder, with results showing fair agreement providing surface roughness effect is taken into account. In the flight, re-laminarization followed the transition in the fore part of HYFLEX in several ten seconds. Based on the fact that Reynolds number based on characteristic length along the flight path decreased when the effect of variable entropy caused by nose bluntness is taken into account, this is surmised to be the cause of the relaminarization.

Author (AIAA)

Aerodynamic Heating; Tiles; Ceramics; Hypersonic Flight

19980055839

Wind tunnel measurements of parafoil geometry and aerodynamics

Matos, C., Georgia Inst. of Technology, Atlanta, USA; Mahalingam, R., Georgia Inst. of Technology, Atlanta; Ottinger, G., Georgia Inst. of Technology, Atlanta; Klapper, J., Georgia Inst. of Technology, Atlanta; Funk, R., Georgia Inst. of Technology, Atlanta; Komerath, N. M., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0606; Copyright; Avail: Aeroplus Dispatch

Video-based photogrammetry combined with a laser sheet is used to measure the section profiles of a parafoil model of aspect ratio 2.5 during tethered testing in a low-speed tunnel. Surface contours of parafoils during operation in a wind tunnel are obtained. Leading-edge collapse, high angle of attack flight, and oscillatory yaw are studied. Force measurements, including CL and CD for the parafoil, are also obtained for the conditions studied.

Author (AIAA)

Wind Tunnel Tests; Parafoils; Photogrammetry

19980055840

An experimental investigation of strong three-dimensional disturbances to a compressible wake

Tarnopolsky, Alex Z., Australian Defence Force Academy, Australia; Gai, Sudhir L., Australian Defence Force Academy, Australia; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0607; Copyright; Avail: Aeroplus Dispatch

Schlieren flow visualization, three types of holographic interferometry together with some pressure measurements have been employed in an investigation of the large-scale structures in the wake behind a blunt flat plate at a Mach number 2.0. Two configurations of trailing edge were studied, a basic blunt plain trailing edge and a castellated blunt trailing edge which imposes strong three dimensional disturbances. The flow visualizations show that the shear layer behind both trailing edges is a superposition of inclined large-scale structures and vortex structures. However, the thickness of the shear layer is much larger behind the castellated trailing edge. The vortex structures showed some periodicity and were seen to be Reynolds number dependent. The Strouhal number measurements showed an eight percent reduction in shedding frequency behind the castellated trailing edge. Also, density gradient in the shear layer was found to be greater with the castellated trailing edge.

Author (AIAA)

Wakes; Blunt Bodies; Flat Plates; Flow Visualization; Holographic Interferometry; Pressure Measurement

19980055841

Semi-span testing at low Reynolds number

Marchman, J. F., III, Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Gunther, C. L., Virginia Polytechnic Inst. and State Univ., Blacksburg; Gundlach, J. F., IV, Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0608; Copyright; Avail: Aeroplus Dispatch

Wind tunnel tests were conducted on low aspect ratio, semi-span wing models to investigate the effect of a gap between the wing root and the wall or end-plate on the measurements of lift at low Reynolds Number. Previous tests with a highly cambered wing had indicated that, unlike testing at higher Reynolds numbers, at chord-based Re values below 500,000, tests with a semi-span model gave different zero-lift angles of attack than tests with an equivalent full wing in the same flow. The present tests were run to verify the previous test results and to determine if this same shift in zero-lift angle of attack occurred with non-cambered,

symmetrical wings of low aspect ratio. Low aspect ratio wings were used in the tests because of their greater sensitivity to flow leakage through a wing/plate gap. The results showed that, while the cambered wing did repeat the previously observed test result, the symmetrical wings exhibited no significant shift in zero-lift angle of attack between the open and closed gap tests.
Author (AIAA)
Low Reynolds Number; Wind Tunnel Tests; Wing Profiles; Airfoil Profiles; Semispan Models

19980055842
Direct circulation measurement of a wing tip vortex using ultrasound
Desabrais, K. J., Worcester Polytechnic Inst., USA; Johari, H., Worcester Polytechnic Inst., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0609; Copyright; Avail: Aeroplus Dispatch

The circulation distribution of a wing tip vortex as a function of the spanwise coordinate was measured directly by a novel ultrasound technique. This technique measures the total circulation enclosed by a rectangular path. To observe the effects of forcing on the vortex structure, blowing along the vortex core was employed. The wing tip vortex was generated by a blunt-ended, rectangular planform NACA 0012 wing with a chord of 10.5 cm and a half-wing aspect ratio of 2.1. The circulation distribution was measured at four chords downstream of the trailing edge of the wing. The circulation distribution behaved as expected achieving its highest level when the closed integration path completely surrounded the vortex. The circulation decreased rapidly through the vortex center before reaching nearly zero circulation outside the vortex. The ultrasound measurements agreed well with detailed circulation measurements derived from velocity field data generated by a similar tip vortex. The vortex was forced by both steady and pulsed injection and extraction of air into the core of the wing tip vortex. For blowing coefficients of 7.10 x 10 exp -6 to 1.16 x 10 exp -4 and a pulsing frequency range of 1-10 Hz, no appreciable changes were measured by the ultrasound method over the baseline flow at the four chord station.
Author (AIAA)
Wing Tips; Vortices; Ultrasonic Wave Transducers; Wing Profiles; Circulation; Airfoil Profiles

19980055843
Effects of wings and tunnel walls on forebody vortex asymmetry
Darden, L. A., Georgia Inst. of Technology, Atlanta, USA; Villareal, L., Georgia Inst. of Technology, Atlanta; Komerath, N. M., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0610; Copyright; Avail: Aeroplus Dispatch

Experiments on the flow over a generic aircraft configuration at high angles of attack, with and without wings, conducted in two wind tunnels, reveal several effects attributed to interaction of the vortex-dominated flow with the various surfaces. The presence of wings is seen to constrain the amplitude and temporal response of forebody-induced vortex asymmetry, so that isolated-forebody yawing moment and asymmetry data appear to overestimate the effectiveness of vortex controllers. Data obtained in two wind tunnels, and from the larger wind tunnel with varying wall proximity are presented to quantify wall interaction effects. It is seen that facility interaction effects are significant even with blockage and wall proximity values which are conservative compared to most of those in the published literature. The data show a global increase in effective angle of attack due to roof proximity, of the order of five degrees. The asymmetry of the vortex system is also amplified by roof effects. Most of the interaction effects are qualitatively consistent with expectations from potential theory, while others are attributed to changes in vortex bursting phenomena.
Author (AIAA)
Wind Tunnel Walls; Forebodies; Vortices; Asymmetry; Aircraft Configurations; Wing Profiles

19980055845
Directional agglomeration multigrid techniques for high Reynolds number viscous flow solvers
Mavriplis, D. J., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0612; Copyright; Avail: Aeroplus Dispatch

A preconditioned directional-implicit agglomeration algorithm is developed for solving two- and three-dimensional viscous flows on highly anisotropic unstructured meshes of mixed-element types. The multigrid smoother consists of a pre-conditioned point- or line-implicit solver which operates on lines constructed in the unstructured mesh using a weighted graph algorithm. Directional coarsening or agglomeration is achieved using a similar weighted graph algorithm. A tight coupling of the line construction and directional agglomeration algorithms enables the use of aggressive coarsening ratios in the multigrid algorithm, which in turn reduces the cost of a multigrid cycle. Convergence rates which are independent of the degree of grid stretching are

demonstrated in both two and three dimensions. Further improvement of the three-dimensional convergence rates through a GMRES technique is also demonstrated.
Author (AIAA)
Multigrid Methods; High Reynolds Number; Viscous Flow; Two Dimensional Flow; Three Dimensional Flow; Navier-Stokes Equation

19980055850
Computational aspects of space-marching
Loehner, Rainald, George Mason Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0617; Copyright; Avail: Aeroplus Dispatch

Computational techniques and implementational issues of a general space-marching algorithm that can be used in conjunction with any explicit timestepping algorithm, works on arbitrary grids, and can treat subsonic pockets are described. The techniques considered are: edge markings, point and edge renumbering, minimization of unnecessary work for the point-arrays, extrapolation of the solution for new active points, proper measures for convergence, the extension of these ideas to transient problems, and macro-blocking. Several examples are included that demonstrate the effectiveness of these techniques.
Author (AIAA)
Time Marching; Supersonic Flow; Ducted Flow

19980055851
Improvements to a Newton-Krylov solver for aerodynamic flows
Pueyo, Alberto, Toronto, Univ., Canada; Zingg, David W., Toronto, Univ., Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0619; Copyright; Avail: Aeroplus Dispatch

We present and justify the strategies and parameters used in PROBE, a Newton-Krylov solver for steady aerodynamic flows. The Krylov solver GMRES is used in matrix-free form. An approximate Jacobian matrix with some modifications to increase the magnitude of the diagonal entries is used to form a preconditioner based on an incomplete lower-upper factorization with two levels of fill. The resulting solver is very efficient, generally reducing the residual twelve orders of magnitude with a CPU expense equivalent to between 500 and 1000 function evaluations. For all cases studied, PROBE converged significantly faster than an approximately-factored multigrid algorithm used for comparison. We propose a convergence rate based on the reduction in the residual obtained in the CPU time required for one function evaluation. With this definition, PROBE achieves a convergence rate per function evaluation between 0.945 and 0.972 for the cases studied, which include inviscid, laminar, and turbulent flows. This is substantially faster than many current algorithms applied to similar flows.
Author (AIAA)
Steady Flow; Aerodynamic Characteristics; Multigrid Methods

19980055852
The effects of the incoming turbulent boundary layer structure on a shock-induced separated flow
Beresh, S. J., Texas, Univ., Austin, USA; Comninos, M., Texas, Univ., Austin; Clemens, N. T., Texas, Univ., Austin; Dolling, D. S., Texas, Univ., Austin; Jan. 1998; In English
Contract(s)/Grant(s): DAAH04-94-G-0190; DAAH04-95-1-0630
Report No.(s): AIAA Paper 98-0620; Copyright; Avail: Aeroplus Dispatch

An experimental study is underway to investigate the effect of the incoming turbulent boundary layer structure on separation shock unsteadiness. The flow in a Mach 5 unswept compression ramp interaction has been investigated using the primary diagnostics of planar laser scattering (PLS) of an alcohol fog and particle image velocimetry (PIV). Double-pulse PLS imaging has been used to acquire image pairs which show the evolution of large-scale boundary layer structures as they pass through the separation shock. It was observed that while turbulent structures greatly distort the outer region of the separation shock, the shock foot does not move appreciably. Correlations between the boundary layer thickness as inferred from the PLS images and the shock motion as determined by pressure transducers mounted in the floor show no discernible relationship between the passage of large-scale turbulent structures and the motion of the separation shock foot. PIV measurements were conducted in the incoming boundary layer to obtain ensemble averages of the streamwise velocity fluctuations conditioned upon the shock foot motion. No correlation was found between these two events. Similarly, no clear trend was observed between the incoming turbulent velocity fluctuations and the velocity of the separation shock foot. These results seem to suggest that the primary source of the separation shock unsteadiness is not the upstream boundary layer, although further work is required before this can be stated definitively.
Author (AIAA)
Turbulent Boundary Layer; Separated Flow; Shock Waves; Particle Image Velocimetry

19980055853

Structure of a compressible boundary layer over a curved wall

Wier, Raymond C., USAF, Research Lab., USA; Bowersox, Rodney D. W., Alabama, Univ., Tuscaloosa; Glawe, Diana D., USAF, Research Lab., USA; Gogineni, Sivaram, Innovative Scientific Solutions, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0621; Copyright; Avail: Aeroplus Dispatch

An experimental analysis of a supersonic turbulent boundary layer distorted by streamwise pressure gradients was performed using particle image velocimetry (PIV) and hot-film anemometry. Four pressure gradients were examined; a zero pressure gradient (M = 2.8), a favorable pressure gradient (M = 3.0) an adverse pressure gradient (M = 2.7), and a combined pressure gradient (M = 2.5). Measurements included mean velocity, velocity turbulence intensity, mass flux turbulence intensity and energy spectra. Instantaneous (10 nsec) Mie scattering flow visualizations were also acquired. Qualitatively, the flow visualizations indicated that the turbulent flow structures were strongly affected by the pressure gradients. The PIV contours and the hot-wire profiles indicated that the boundary layer thickness increased 40 percent and decreased 30 percent, as compared to the zero pressure gradient, for the favorable and adverse pressure gradients, respectively. Further, the PIV and hot-wire data indicated that the axial turbulence intensity levels increased 22 percent for the adverse pressure gradient and combined pressure gradient, and decreased 25 percent for the favorable pressure gradient as compared to the zero pressure gradient. The energy spectra data indicated the pressure gradient (favorable or adverse) increased the energy transfer to the higher frequencies.

Author (AIAA)

Compressible Boundary Layer; Supersonic Boundary Layers; Turbulent Boundary Layer; Pressure Gradients; Particle Image Velocimetry

19980055855

Planar visualizations of large-scale turbulent structures in axisymmetric supersonic base flows

Bourdon, Christopher J., Illinois, Univ., Urbana, USA; Smith, Kenneth M., Illinois, Univ., Urbana; Dutton, J. Craig, Illinois, Univ., Urbana; Mathur, Tarun, Illinois, Univ., Urbana; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0624; Copyright; Avail: Aeroplus Dispatch

The spatial evolution of large-scale turbulent structures in an axisymmetric, supersonic base flow has been investigated. The experimental diagnostic used was planar visualization of condensed ethanol droplets that were suspended in the supersonic freestream. Spatial correlation analyses of large ensembles of images show that the mean side-view structure is highly strained and elliptical in shape and is inclined toward the local freestream direction. It is also shown that the effect of lateral streamline convergence for this axisymmetric case causes a reduction in structure size and eccentricity at the reattachment point. End-view structures are wedge-shaped, wider on the freestream side than on the recirculating or developing wake side. It is concluded that the wedge shape is caused by the axisymmetric confinement of the shear layer as it approaches the wake centerline. The average number of structures present in the endview plane decreases significantly from 10-14 at recompression to 4-5 in the developing wake region. Evidence of an amalgamation of end-view structures in the images at the reattachment point illustrates one of the mechanisms responsible for this reduction.

Author (AIAA)

Base Flow; Supersonic Flow; Axisymmetric Flow; Flow Visualization

19980055859

Mean velocity and pressure and velocity spectral measurements within a separated flow around a prolate spheroid at incidence

Goody, Michael C., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Simpson, Roger L., Virginia Polytechnic Inst. and State Univ., Blacksburg; Engel, Mark, Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0630; Copyright; Avail: Aeroplus Dispatch

Hot-wire velocity measurements were made on the lee-side of a 6:1 prolate spheroid, ReL = 4.2 x 10 exp 6, at 10 and 20 deg angles of attack, and at x/L = 0.600 and 0.772. The dominant feature of each of these flowfields is the presence of a shed vortex due to cross-flow separation. This is a source of considerable noise and vibration. At an angle of attack of 10 degrees the most turbulent fluid is confined to the near wall region. At an angle of attack of 20 deg the most turbulent fluid appears away from the wall at locations where the flow is separating. Velocity spectra for regions with weaker 3-D effects exhibit features that are observed for equilibrium flows. Spectra in strong vortical flow regions show unusual and apparently non-equilibrium behavior. This behavior has some qualitative similarities with surface pressure fluctuation spectra.

Author (AIAA)

Velocity Measurement; Pressure Measurement; Separated Flow; Prolate Spheroids; Incidence

19980055887

Grooves effect on lift force - Data correlation and prediction for kinetic energy projectiles

Mikhail, Ameer G., U.S. Army, Propulsion and Flight Div., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0671; Copyright; Avail: Aeroplus Dispatch

The effect of grooves on the normal force of an antiarmor long rod kinetic energy (KE) projectile is analyzed and numerically quantified. The effect was studied for body-alone and body with fins where clear and distinct effects were experimentally observed for each. Wind tunnel data sets were analyzed and an algebratic, semi-empirical correlations were constructed utilizing the main physical parameters of the projectile body and fins, as well as the flow parameters. The correlations provide a simple method to estimate the increase or decrease in the vehicle total normal force due to grooves, and can be implemented in fast aerodynamics design codes. One separate set of data was dedicated for independent validation, and the correlation predicted the effect well, both in magnitude and sign. The present correlation is the only one known for predicting the lift loss (or gain) due to grooves. In addition, a better understanding of the contributions of grooves to both body-alone and fins-in-presence-of-body, is presented.

Author (AIAA)

Aerodynamic Forces; Lift; Surface Roughness Effects; Data Correlation; Aerodynamic Stability

19980055893

Experimental evaluation of penalty associated with micro-blowing for reducing skin friction

Hwang, DannyP., NASA Lewis Research Center, USA; Biesiadny, Tom J., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0677; Copyright; Avail: Aeroplus Dispatch

A micro-blowing technique (MBT) experiment was conducted in the Advanced Nozzle and Engine Components Test Facility at NASA/Lewis. The objectives of the test were to evaluate the pressure-drag penalty associated with the MBT and to provide additional information about the porous plates used for microblowing. The results showed that 1 of 12 plates tested could reduce the total drag (skin-friction drag plus pressure drag) below a solid flat plate value. The results of this experiment and prior data showed that a total drag reduction below a solid flat plate value was possible. More tests are needed to find an optimal MBT skin and to find a technique to reduce pressure drag.

Author (AIAA)

Skin Friction; Blowing; Penalty Function; Pressure Drag

19980055895

Numerical simulation of transonic flow over Space Shuttle Orbiter tail

Rajagopal, Karuna, Boeing North American, Inc., USA; Ortiz, Carlos, Boeing North American, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0679; Copyright; Avail: Aeroplus Dispatch

Wind tunnel tests and CFD analyses are under way to generate transonic aerodynamic loads data between Mach 0.9 and 1.0 for the Space Shuttle Orbiter vertical tail. The outboard rudder shear load is in the direction opposite to the incoming flow in both the flight and wind-tunnel data around Mach = 0.9. The flow simulations conducted thus far demonstrate this phenomenon and provide the variation in the reverse loading vs the side-slip angle, the effects of geometry details, and Reynolds number effects at Mach = 0.9.

Author (AIAA)

Transonic Flow; Space Shuttle Orbiters; Tail Assemblies; Computational Fluid Dynamics

19980055896

Aerodynamic interference for hypersonic missiles at low angle of attack

Nelson, H. F., Missouri-Rolla, Univ., Rolla, USA; Hillstrom, G., Missouri-Rolla, Univ., Rolla; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0680; Copyright; Avail: Aeroplus Dispatch

The Euler code (ZEUS) is used to predict the flow field over a hypersonic missile and to determine the carryover factors K sub(B) for the wing lift in the presence of the fuselage and K sub B(W) for the lift produced by the fuselage in the presence of the fins. Results are presented at Mach 6, 8, and 10, for a 2-deg angle of attack, and a ratio of specific heats (gamma) of 1.4 and 1.3. gamma = 1.3 partially accounts for chemistry effects. K sub W(B) and K sub B(W) are determined for ratios of fin span to body radius at the fin leading edge, S/R(LE) from 1 to 5 for a missile with an aspect ratio of 1.53. Both K sub W(B) and K sub B(W) have approximately the same variation with fin size as the slender body predictions.

Author (AIAA)

Angle of Attack; Aerodynamic Interference; Hypersonic Vehicles; Antimissile Missiles; Body-Wing Configurations; Hypersonic Flow; Missile Configurations

19980055898

Experimental verification of the osculating cones method for two waverider forebodies at Mach 4 and 6

Miller, R. W., Colorado, Univ., Boulder, USA; Argrow, B. M., Colorado, Univ., Boulder; Center, K. B., Centerstage Animated Reconstructions, USA; Brauckmann, G. J., NASA Langley Research Center, USA; Rhode, M. N., NASA Langley Research Center, USA; Jan. 1998; In English

Contract(s)/Grant(s): NGT-1-52134

Report No.(s): AIAA Paper 98-0682; Copyright; Avail: Aeroplus Dispatch

The NASA Langley Research Center Unitary Plan Wind Tunnel and the 20-Inch Mach 6 Tunnel were used to test two osculating cones waverider models. The Mach-4 and Mach-6 shapes were generated using the interactive design tool WIPAR. WIPAR performance predictions are compared to the experimental results. Vapor screen results for the Mach-4 model at the on-design Mach number provide visual verification that the shock is attached along the entire leading edge, within the limits of observation. WIPAR predictions of pressure distributions and aerodynamic coefficients show general agreement with the corresponding experimental values.

Author (AIAA)

Double Cusps; Waveriders; Forebodies; Wind Tunnel Tests; Cones; Mach Number

19980055899

Hypersonic flow over a flat plate

Toro, P. G. P., Rensselaer Polytechnic Inst., USA; Rusak, Z., Rensselaer Polytechnic Inst., USA; Nagamatsu, H. T., Rensselaer Polytechnic Inst., USA; Myrabo, L. N., Rensselaer Polytechnic Inst., USA; Jan. 1998; In English

Contract(s)/Grant(s): NCC8-112

Report No.(s): AIAA Paper 98-0683; Copyright; Avail: Aeroplus Dispatch

The viscous boundary layer flow near the leading edge of a flat plate given in supersonic and hypersonic speeds is numerically investigated. The boundary layer and shock wave may merge near the leading edge depending on the Mach number, Reynolds number, and wall temperature. We consider air as calorically perfect gas, with a constant Prandtl number and Sutherland's law for the viscosity. The 2D Navier-Stokes equations for a nonsteady flow, with no body forces, no volumetric heating, and no mass diffusion are solved using the explicit finite-difference MacCormack's time marching technique. Solutions for the flow parameters, such as the boundary layer thickness, the pressure profile in both directions (x and y directions), the streamwise velocity profile, and the temperature and density distributions over a flat plate with constant surface temperature, are presented. The numerical results are also compared with recent similarity solutions for supersonic laminar boundary layers that use a general power law for the viscosity-temperature relation. Good agreement between the solutions is found at the trailing edge of the plate.

Author (AIAA)

Flat Plates; Hypersonic Flow; Boundary Layer Flow; Viscous Flow; Leading Edges; Supersonic Flow

19980055900

Characterization of the flowfield near a wrap-around fin at Mach 4.9

Tilmann, C. P., USAF, Research Lab., USA; Bowersox, R. D., Alabama, Univ., Tuscaloosa; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0684; Copyright; Avail: Aeroplus Dispatch

The flow field near a single wrap-around fin on a semicylindrical body has been investigated experimentally and numerically with the objective of quantifying the flow structure in the region near the fin/body juncture at a Mach number of 4.9 and a unit Reynolds number of about 75 x 10 exp 6/m. For the numerical simulation, the Navier-Stokes equations were solved employing an algebraic eddy viscosity model. In the experiment, mean flow data were obtained in the AFIT Mach 5 wind tunnel using conventional pitot and cone-static pressure probes. Shadowgraph and schlieren photography were also used for flow visualization. Comparisons between numerical and experimental data suggest that the calculations have captured the flow physics involved in this complicated flow field. Comparisons of the numerical results to those previously obtained at Mach 2.8 suggest that the flow structure near the WAF is qualitatively invariant over this range. In particular, the vortical flow structure near the fin/body juncture which was characterized in the Mach 2.8 study is also present at Mach 4.9.

Author (AIAA)

Flow Distribution; Characterization; Mach Number; Finned Bodies; Aerodynamic Configurations; Flow Measurement; Computational Fluid Dynamics

19980055901

Analytical modeling of jet unsteadiness in hypersonic type IV shock interactions

Frame, Michael J., Maryland, Univ., College Park, USA; Lewis, Mark J., Maryland, Univ., College Park; Jan. 1998; In English

Contract(s)/Grant(s): NAGW-11796
Report No.(s): AIAA Paper 98-0685; Copyright; Avail: Aeroplus Dispatch

The unsteadiness associated with the impinging supersonic jet in a type IV shock-shock interaction at hypersonic speeds is investigated using an analytical model. The analytical model is used to show how the shear layers surrounding the jet can cause a buildup of vorticity at the shear layer end points. The point vortices forming at these locations have unequal strengths, and this imbalance results in a deflection of the jet flow impinging on the body surface. The periodic breaking-away of the upper vortex can be shown to cause the jet flow to oscillate, as observed in experimental and computational results.
Author (AIAA)
Shock Wave Interaction; Hypersonic Flow; Jet Flow; Unsteady Flow; Jet Impingement

19980055902
Three-dimensional shock/boundary-layer interactions in supersonic and hypersonic flows
Petterson, K., Cranfield Univ., UK; Duquesne, N., Royal Inst. of Technology, Sweden; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0686; Copyright; Avail: Aeroplus Dispatch

Navier-Stokes computations are performed for the 3D shock-wave/turbulent boundary-layer interactions generated by, firstly, a 13-deg sharp fin at Mach 2.0, Re/m = 9.2 x 10 exp 7 and, secondly, a 10-deg sharp fin at Mach 6.2, Re/m = 4.01 x 10 exp 7. The flow field is computed by integrating the Favre-averaged Navier-Stokes equations. The turbulence models considered are a classic algebraic Baldwin-Lomax and the one equation model of Spalart-Allmaras. Both sets of data are compared with experimentally derived information. The numerical solutions predict most of the essential features of the flow field. The computed cross-stream surface pressure coefficients profiles for the supersonic case show excellent agreement with the experimental values.
Author (AIAA)
Three Dimensional Flow; Supersonic Flow; Hypersonic Flow; Computational Fluid Dynamics; Navier-Stokes Equation; Fins

19980055903
Physics of buffeting flows over delta wings
Gursul, I., Cincinnati, Univ., USA; Xie, W., Cincinnati, Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0688; Copyright; Avail: Aeroplus Dispatch

Experimental evidence suggests that vortex breakdown is not the only source of buffeting of delta wings and fins. Other unsteady flow phenomena that contribute to buffeting are vortex wandering, fluctuations of vortex breakdown location, and vortex shedding. These phenomena and their physical models were discussed. Flow visualization and velocity measurements were carried out over a delta wing, over a wide range of angle of attack, in order to understand the transition between the helical mode instability and vortex shedding. It was found that this transition is abrupt, as indicated by a jump in the frequency parameter, and occurred at the angle of attack at which breakdown reached the apex. The unsteady nature of vortex breakdown location was investigated by flow visualization for the interaction of vortex breakdown with a flat plate. Although there are indications of a feedback effect on vortex breakdown, the amplitude of the fluctuations of breakdown location is smaller for impinging flows.
Author (AIAA)
Delta Wings; Buffeting; Flow Visualization; Vortex Shedding; Helical Flow; Flow Stability; Transition Flow

19980055906
Measurements of the near wake of a rotor in forward flight
Mahalingam, Raghav, Georgia Inst. of Technology, Atlanta, USA; Komerath, Narayanan M., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0692; Copyright; Avail: Aeroplus Dispatch

This paper describes initial measurements of the near wake of a two-bladed teetering, untwisted, square-tipped rotor in forward flight. Issues of periodicity and repeatibility of the core are studied using laser velocimetry and flow-visualization on the front of the rotor wake where cycle to cycle variations are expected. Core passage uncertainty from cycle to cycle is less than 1 deg of rotor azimuth. Velocity measurements on the advancing blade side show wakelike core-axial velocities higher than the core circumferential velocity for the first 180 deg of vortex age. Both the axial and circumferential velocities approach 50 percent of blade tip speed. The inboard vortex sheet has substantial wakelike velocities, and rolls up into a concentrated circulatory region of high wake-like axial velocity rotating opposite to the tip-vortex, within 30 deg from the blade. The fully-developed values of the vortex core circulation, radius, and axial velocity remain constant over 180 deg of age, as current measurements indicate.
Author (AIAA)
Near Wakes; Flow Measurement; Rotor Aerodynamics; Helicopter Wakes

19980055907

Initial peak vorticity behavior for vortices shed from airfoil vortex generators

Wendt, B. J., Modern Technologies Corp., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0693; Copyright; Avail: Aeroplus Dispatch

Simple 2D models of a vortex are constructed to mimic a vortex newly shed from an airfoil vortex generator. The model vortices have Oseen-like properties, and are constructed in terms of circulation and peak vorticity. The models are integrated for cross-plane angular momentum, and an expression based on Prandtl's relationship between finite airfoil circulation and airfoil geometry is substituted for vortex circulation. Using a conservation relationship, peak vorticity of the shed vortex is then isolated in terms of vortex generator geometry. Results indicate a good comparison to data taken on low aspect ratio airfoil vortex generators. The influence of the wall is studied using a patchwork model vortex patterned after the Rankine vortex. The wall is modeled by superimposing an image vortex. Both the analysis and the data indicate that the presence of the wall depresses the magnitude of peak vorticity for the lowest values of aspect ratio and span-to-boundary layer thickness ratio.

Author (AIAA)

Vortex Generators; Vortex Shedding; Vorticity; Airfoils; Two Dimensional Models

19980055910

Mixing enhancement with minimal thrust loss in a high speed rectangular jet

Kim, J.-H., Ohio State Univ., Columbus, USA; Samimy, M., Ohio State Univ., Columbus; Erskine, W. R., Ohio State Univ., Columbus; Jan. 1998; In English

Contract(s)/Grant(s): F49620-97-1-0493; NAG3-1724; NAG3-1986

Report No.(s): AIAA Paper 98-0696; Copyright; Avail: Aeroplus Dispatch

An aspect ratio 3 rectangular nozzle with design Mach number 2 was used to investigate the effects of double-trailing edge modifications on mixing enhancement and thrust generated by the jet at the fully expanded jet Mach numbers 1.75, 2.0, and 2.5. The trailing edge modifications are simple cut-outs in the plane of the nozzle at the nozzle exit. The jet cross sections were visualized by the laser sheet illumination technique to obtain mixing characteristics of the jet, and a thrust measuring system was built and used to measure thrust variations with the modifications. It was found that the pair of streamwise vortices generated by the modified trailing edge at one side of the nozzle in the underexpanded flow regime did not interact with the pair of streamwise vortices generated by the modified trailing edge on the other side for a large downstream distance, due to the expansion of the jet cross section for this flow regime. As a result, each modified trailing edge acted almost independently; thus, substantial mixing enhancement was achieved using double trailing edge modifications. No measurable thrust loss or gain was obtained, for either single- or double-trailing edge modifications, regardless of the type of modifications. Therefore, the use of trailing edge modifications is a promising technique for mixing enhancement with minimal thrust loss, especially in underexpanded flow regimes.

Author (AIAA)

High Speed; Mixing; Trailing Edges; Rocket Thrust

19980055911

Velocity field of the planar shear layer - Compressibility effects

Urban, William D., Stanford Univ., USA; Watanabe, Shigeya, Stanford Univ., USA; Mungal, M. G., Stanford Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0697; Copyright; Avail: Aeroplus Dispatch

Particle image velocimetry (PIV) is used to measure the instantaneous 2D velocity field in turbulent, planar mixing layers at varying levels of compressibility. The structure of the instantaneous velocity and vorticity fields are seen to display similar variation with compressibility as the scalar field, with the spatial intermittency of the velocity field tied to the interfaces of the large-scale structures. The compressible case displays multiple thin sheets of vorticity within the layer, rather than diffuse regions spanning its transverse extent. The importance of the lab-frame Mach number, particularly in compressible layers, is suggested by the presence of steep velocity gradients near the instantaneous sonic line within the mixing layer. In addition to lending structural interpretations such as these, the PIV data may also be used in large-ensemble fashion to provide turbulence statistics previously obtained using pointwise measurement techniques. The effect of subboundary layer mixing enhancement techniques on the velocity field is observed by means of plan-view measurements.

Author (AIAA)

Velocity Distribution; Two Dimensional Flow; Shear Layers; Compressible Flow; Flow Measurement; Flow Velocity; Particle Image Velocimetry

19980055912

Velocity measurements in a shock-separated free shear layer

Palko, C. W., Aerospace Corp., USA; Dutton, J. C., Illinois, Univ., Urbana; Jan. 1998; In English

Contract(s)/Grant(s): DAAH04-93-G-0226

Report No.(s): AIAA Paper 98-0698; Copyright; Avail: Aeroplus Dispatch

Two-component LDV measurements were made in a planar, shock-separated free shear layer formed by the convergence of two supersonic streams past a thick plate. High-speed wall pressure measurements locate the unsteady shock wave formed by this interaction and, consequently, allow separation of the effects of shock motion from the turbulence fluctuations in the velocity measurements of the shear layer. Shock-induced separation dramatically increases the normal stresses and shear stress. The shock-separated shear layer displays a positive shear stress region between separation and reattachment. Reattachment produces a shift in turbulent kinetic energy from the streamwise component to the transverse component. The region of shock motion has a relatively constant width irrespective of distance from the wall.

Author (AIAA)

Velocity Measurement; Separated Flow; Laser Doppler Velocimeters; Shear Layers; Flow Velocity

19980055914

Reynolds-averaged Navier-Stokes simulations of two partial-span flap wing experiments

Takallu, M. A., Lockheed Martin Engineering & Sciences, USA; Laflin, Kelly R., NASA Langley Research Center, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS1-96014

Report No.(s): AIAA Paper 98-0701; Copyright; Avail: Aeroplus Dispatch

Structured Reynolds-averaged Navier-Stokes simulations of two partial-span flap wing experiments were performed to accurately document the acoustic and aerodynamic characteristics associated with principal airframe noise sources, including flap side-edge noise; measurements were taken to validate analytic and computational models of the noise sources and associated aerodynamics for configurations and conditions approximating flight for transport aircraft. The numerical results are used to both calibrate a widely used CFD code, CFL3D, and to obtain details of flap side-edge flow features not discernible from experimental observations. Both experimental set-ups were numerically modeled by using multiple block structured grids. Various turbulence models, grid block-interface interaction methods and grid topologies were implemented. Numerical results of both simulations are in excellent agreement with experimental measurements and flow visualization observations. The flow field in the flap-edge region discerned crucial information about the flow physics and substantiated the merger of the two vortical structures. As a result of these investigations, airframe noise modelers have proposed various simplified models which use the results obtained from the steady-state computations as input.

Author (AIAA)

Reynolds Averaging; Navier-Stokes Equation; Wing Flaps; Wind Tunnel Tests; Computational Fluid Dynamics; Aeroacoustics; Semispan Models

19980055915

Prediction of laminar/turbulent transition in airfoil flows

Johansen, Jeppe, Riso National Lab., Denmark; Sorensen, Jens N., Technical Univ. of Denmark, Lyngby; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0702; Copyright; Avail: Aeroplus Dispatch

The prediction of the location of transition is important for low Reynolds number airfoil flows. The laminar/turbulent properties of the flowfield have an important influence on skin friction and separation and therefore on lift and drag characteristics. Transition is here predicted using the more general transition prediction method, the e exp n model, and compared to the simple empirical Michel criterion. The flow is computed using an incompressible Navier-Stokes solver and the turbulent region is computed with the two-equation k-omega SST model. The e exp n method is based on linear stability analysis employing the Orr-Sommerfeld equation to determine the growth of spatially developing waves. In order not to compute growth rates for each velocity profile, a database with integral boundary layer parameters as input has been established. The problem of determining boundary layer properties using a Navier-Stokes solver is solved using a two-equation integral formulation, which is solved using a direct/inverse Newton-Raphson method. The test cases are incompressible transitional flows around airfoils at low and moderate Reynolds numbers, at fixed angles of attack, from attached flow through light stall. For lower Reynolds numbers, the e exp n method shows better agreement with experiments.

Author (AIAA)

Transition Flow; Airfoils; Low Reynolds Number; Computational Fluid Dynamics; Prediction Analysis Techniques; Orr-Sommerfeld Equations; Navier-Stokes Equation

19980055916

Transition on a three-element high lift configuration at high Reynolds numbers

Bertelrud, Arild, Analytical Services & Materials, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS1-96014

Report No.(s): AIAA Paper 98-0703; Copyright; Avail: Aeroplus Dispatch

As part of a high-lift flow physics experiment at high Reynolds numbers to be used for code-validation, the location and extent of laminar/turbulent transition has been determined for a wide variety of conditions (more than 90 combinations of configuration, Reynolds number, Mach number and angle of attack). A database has been established to make the data accessible. In the present paper, the methodology developed to determine the transition region extent and search for possible separated regions on the model is described. The transition characteristics found are described with emphasis on Reynolds number effects. Features of importance for the use of experimental transition data as input for computational codes are also included, with a discussion of the validity of 2D testing and matters regarding accuracy and repeatability.

Author (AIAA)

High Reynolds Number; Transition Flow; Computational Fluid Dynamics; Pressure Distribution; Lift

19980055917

An experimental investigation of unsteady effects in a high-lift system

Thomas, Flint O., Notre Dame, Univ., USA; Nelson, Robert C., Notre Dame, Univ., USA; Liu, Xiaofeng, Notre Dame, Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG2-905

Report No.(s): AIAA Paper 98-0704; Copyright; Avail: Aeroplus Dispatch

A previous fundamental investigation of the confluent boundary layer formed by the interaction of the slat wake with the main element boundary layer of a multielement airfoil observed significant unsteady high lift flow behavior for certain slat positions. These unsteady motions can have a strong effect on the aerodynamic performance of the high lift system. This appears related to the observation that the unsteady flow caused more aggressive mixing between the slat wake and main wing boundary layer. This results in a decrease in high lift performance and an increase in airframe noise. This unsteady aspect of the high lift flow field is our focus. Experimental evidence of unsteady flow field behavior suggests that the unsteady flow behavior is a manifestation of unsteady vortex shedding and separated shear layer reattachment associated with the slat cove separation region. The wavelet analysis technique is shown to be a powerful tool for characterizing transient flow phenomena. Some representative wavelet transform results obtained in the slat wake are presented and discussed. We describe other current efforts to understand the unsteady aspects of high-lift flows.

Author (AIAA)

Lift; Unsteady Flow; Wavelet Analysis; Leading Edge Slats

19980055918

Compressible dynamic stall calculations incorporating transition modeling for variable geometry airfoils

Geissler, W., DLR, Inst. fuer Stroemungsmechanik, Germany; Sobieczky, H., DLR, Inst. fuer Stroemungsmechanik, Germany; Carr, L. W., NASA Ames Research Center, USA; Chandrasekhara, M. S., NASA, USA; Wilder, M. C., MCAT, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0705; Copyright; Avail: Aeroplus Dispatch

Compressible dynamic stall flow over an NACA 0012 airfoil undergoing large amplitude pitching oscillations at a freestream Mach number of 0.3 and a Reynolds number of 1.1 x 10 exp 6 has been computed by incorporating the transition physics that are an integral part of the compressible dynamic stall process. The computed results have been compared with interferogram-generated pressure distributions for a range of angles to validate the model. The resulting model has been applied in a preliminary study of the flow over a dynamically deforming leading edge (DDLE) airfoil. The DDLE airfoil is being used as a novel concept for controlling dynamic stall for a variety of flow conditions. The fundamental fluid physical aspects of the flow are discussed, along with the observed influence of transition modeling on the proper representation of the airfoil flow.

Author (AIAA)

Compressible Flow; Aerodynamic Stalling; Variable Geometry Structures; Airfoils; Transition Flow

19980055932

On the effect of inlet conditions on particle/droplet dispersion in a shear layer

Soteriou, Marios C., Connecticut, Univ., Storrs, USA; Yang, Xu, Connecticut, Univ., Storrs; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0719; Copyright; Avail: Aeroplus Dispatch

The impact of the inlet conditions on particle/droplet dispersion in a posttransitional shear layer is investigated using 2D numerical simulations. The flow inlet conditions are varied between a monotonically changing inlet velocity profile (error function) and one that exhibits a wake deficit reminiscent of the presence of the upstream splitter plate. The particle field inlet conditions are varied by altering the particle inlet location. Monodisperse dilute particle fields of various diameters are considered. The numerical models for both the time-dependent and unaveraged flow and particle fields are Lagrangian yielding a totally grid-free approach. The well known relationship between the particle Stokes number and dispersion is verified. Results also indicate that, under most conditions, dispersion is increased if particles are introduced from the fast stream side and as close as possible to the layer centerline. This trend is more pronounced for the wake-modified than the error-function inlet profile flow. The impact of the Stokes number on this trend is secondary.
Author (AIAA)
Shear Layers; Inlet Flow; Transition Flow; Drops (Liquids); Two Phase Flow; Computational Fluid Dynamics; Numerical Flow Visualization

19980055936
Experimental investigation on dual-purpose cavity in supersonic reacting flows
Yu, K., U.S. Navy, Naval Air Warfare Center, USA; Wilson, K. J., U.S. Navy, Naval Air Warfare Center, USA; Smith, R. A., U.S. Navy, Naval Air Warfare Center, USA; Schadow, K. C., U.S. Navy, Naval Air Warfare Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0723; Copyright; Avail: Aeroplus Dispatch

Experimental studies are in progress to investigate the possible use of cavities for performance gain in a supersonic reacting flowfield. While high-speed flow over an open cavity may or may not result in high amplitude resonance, depending on the cavity dimensions, both situations are of interest because a recirculating cavity flow would provide stable flameholding while an unstable cavity could be used to enhance the rate of turbulent mixing. Several wall cavities with various sizes and aspect ratios were evaluated for flow stability characteristics with a Mach 2 air stream, and were placed inside a combustor where exothermic reaction occurred between high-temperature fuel-rich products from a gas generator and Mach 2 air flow. The preliminary results obtained from a series of open flow testing are presented in this paper. Both stable and unstable cavities were tested with reacting flow, which was created by injecting the fuel-rich products at 45 deg into the Mach 2 air stream. Flame length and luminosity were substantially modified by the use of such cavities.
Author (AIAA)
Cavities; Supersonic Flow; Reacting Flow; Supersonic Combustion; Recirculative Fluid Flow

19980055959
Unsteady transonic integral equation scheme for trajectory simulation of stores
Bhattacharya, A. K., Aeronautical Development Agency, India; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0751; Copyright; Avail: Aeroplus Dispatch

A hybrid integral equation - finite volume scheme is developed to solve the unsteady full potential equation for aerodynamic predictions on stores released from aircraft, inclusive of dynamic effects. The hybrid scheme discretizes the problem using surface panels embedded in a configuration-independent rectangular field grid; such an arrangement is 'naturally' conducive to solve for problems over configurations with components in relative motion, as typical of the separating store problem. Computed aerodynamics is accuracy-accretized by accounting for real flow effects, through synthesis with a-priori test data on stores in freestream using concurrently developed concepts. Aerodynamic prediction techniques are synergized with store and aircraft flight dynamics in the present AMAR code to simulate trajectories of arbitrary stores released from aircraft under steady or maneuvering conditions. The code automatically selects an optimum time step 'Delta-t' for numerical integration of 6-DOF equations under constraints of high simulation accuracy and low computation time. Results are presented on simulated trajectories of fuel tanks released from a fighter aircraft at subsonic and transonic speeds.
Author (AIAA)
Unsteady Aerodynamics; Transonic Flow; Finite Volume Method; External Store Separation; Trajectory Analysis; Wind Tunnel Tests

19980055960
Navier-Stokes computations of sabot discard using a Chimera scheme
Ferry, Earl N., Jr., U.S. Army, Research Lab., USA; Sahu, Jubaraj, U.S. Army, Research Lab., USA; Heavey, Karen R., U.S. Army, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0752; Copyright; Avail: Aeroplus Dispatch

CFD calculations have been performed for a multibody system consisting of a main projectile and three sabot components. Numerical flow-field computations have been made for various orientations and locations of sabots using an unsteady, zonal Navier-Stokes code and the Chimera composite grid discretization technique at a freestream Mach number of 4.0 and alpha of 0. Computational grids have been obtained for the projectile and sabot independently and then overset to form the complete grid system. Computed results have been obtained for sabot angles of attack of 5, 10, 15, and 25 deg. Computed results show the details of the expected flow-field features, including the shock interactions. Both laminar and turbulent computations for the 25-deg case predict similar results. Computed results for other sabot positions are compared with the experimental data obtained in Canada for the same configuration and conditions and are generally found to be in good agreement with the data.
Author (AIAA)
Sabot Projectiles; Navier-Stokes Equation; Computational Grids; Shock Wave Interaction

19980055964

Computation of pre- and post-stall flows over single and multi-element airfoils

Hung, Kuohsing, Wichita State Univ., USA; Papadakis, Michael, Wichita State Univ., USA; Wong, See-Ho, Wichita State Univ., USA; Wong, See-Cheuk, Wichita State Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0756; Copyright; Avail: Aeroplus Dispatch

The Navier-Stokes equations were used to predict the stall and post-stall behavior of five single element airfoils and a multi-element airfoil at low freestream Mach numbers. Results from a comprehensive numerical investigation are presented and compared with experimental force and pressure data. Two numerical schemes were used to integrate the governing equations and three turbulence models were applied to compute turbulent flow properties. The effect of grid resolution on the computational results is discussed. In most cases, the computed force and pressure coefficients obtained for a modified NACA 2412, a NACA 4412, a NLF 0414, a GA(W)-2, and an NREL S809 airfoil with 40 percent chord vented aileron and 40 percent chord spoiler flap, were in acceptable agreement with experimental data.
Author (AIAA)
Aerodynamic Stalling; Airfoil Profiles; Separated Flow; Aerodynamic Forces; Computational Grids

19980055975

Reynolds averaged Navier-Stokes computations of a flap side-edge flow field

Khorrami, Mehdi R., High Technology Corp., USA; Singer, Bart A., High Technology Corp., USA; Radeztsky, Ronald H., Jr., High Technology Corp., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20059; NAS1-20103
Report No.(s): AIAA Paper 98-0768; Copyright; Avail: Aeroplus Dispatch

An extensive computational investigation of a generic high-lift configuration comprising a wing and a half-span flap reveals details of the mean flow field for flap deflections of 29 and 39 degrees. The computational effort involves solutions of the thin layer form of the Reynolds Averaged Navier-Stokes (RANS) equations. For both flap deflections, the steady results show the presence of a dual-vortex system; a strong vortex forming on the lower portion of the flap side edge and a weaker one forming near the edge on the flap top surface. Downstream, the vortex on the flap side edge grows and eventually merges with the vortex on the flap top surface. Comparison of on- and off-surface flow quantities with the experimental measurements of Radeztsky, Singer and Khorrami (AIAA Paper 98-0700) show remarkable agreement. For the 39 degree flap deflection, the calculation also reveals the occurrence of a vortex breakdown, which is corroborated by 5-hole probe velocity measurements performed in the Quiet Flow Facility at NASA Langley. The presence of the vortex breakdown significantly alters the flow field near the side edge.
Author (AIAA)
Wing Span; Noise Prediction (Aircraft); Airfoil Profiles; Wing Flaps; Reynolds Averaging; Vortex Breakdown

19980055979

Numerical simulation of hypersonic flow over a sphere with surface injection

Dendou, Eishin, Tohoku Univ., Japan; Sawada, Keisuke, Tohoku Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0773; Copyright; Avail: Aeroplus Dispatch

Numerical simulation of hypersonic flow over a blunt body is carried out for the purpose of examining the effect of surface injection flow in promoting turbulence effect in the boundary layer. In the calculation, injection flow is assumed to be turbulent according to the Park's injection-induced turbulence model which is implemented in an appropriate one-equation turbulence model. Obtained numerical results are compared with existing experimental data on the velocity profile in the boundary layer. It is shown that a turbulent boundary layer develops when surface injection flow is introduced, even for a laminar upstream flow. A reasonable agreement is obtained for velocity profile at the vicinity of solid wall, but a large discrepancy is seen in the middle

of boundary layer. Efforts are made to improve the agreement by changing injection rate, time constant of porous material, and free stream eddy viscosity, but none gives a totally satisfactory agreement. Inability of the turbulence model in calculating a boundary layer flow with a favorable pressure gradient is suggested as the probable cause.
Author (AIAA)
Hypersonic Flow; Fluid Injection; Turbulent Flow; Blunt Bodies; Turbulence Models; Boundary Layer Flow

19980055980

Numerical investigation of a three-dimensional turbulent shock/shock interaction

Duquesne, N., Royal Inst. of Technology, Sweden; Alziary de Roquefort, T., Lab. d'Etudes Aerodynamiques, France; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0774; Copyright; Avail: Aeroplus Dispatch

A collaborative experimental and numerical study is presented for a three-dimensional shock-shock interaction in hypersonic flows at Mach 7.14. The test case is a swept circular cylinder on which impinges an oblique shock wave generated by a swept wedge at the same sweep angle. The flow field is computed by integrating either the full Navier-Stokes equations for laminar flow or the Reynolds averaged Navier-Stokes equations for turbulent flow. The turbulence models considered are firstly a classic algebraic Baldwin-Lomax model and then several near-wall versions of the k-epsilon model. The results of a parametric numerical study show a very high sensitivity to small variations in the boundary conditions and indicate clearly that the code validation process requires a careful analysis of all the sources of error and a systematic variation of the governing parameters. Some discrepancies between experimental and numerical results can be attributed to an uncertainty in the impinging shock location. By adjusting properly the impinging shock location in the computation, a fairly good agreement between the experimental and numerical pressure and heat transfer distributions is obtained.
Author (AIAA)
Hypersonic Vehicles; Oblique Shock Waves; Turbulent Flow; Shock Wave Interaction; K-Epsilon Turbulence Model; Baldwin-Lomax Turbulence Model

19980055981

Shock/shock interaction experiments in the High Enthalpy Shock Tunnel Goettingen

Carl, M., DLR, Inst. fuer Stroemungsmechanik, Germany; Hannemann, V., DLR, Inst. fuer Stroemungsmechanik, Germany; Eitelberg, G., DLR, Inst. fuer Stroemungsmechanik, Germany; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0775; Copyright; Avail: Aeroplus Dispatch

Shock/shock-interaction studies have been conducted in the High Enthalpy Shock Tunnel Goettingen (HEG). A cylinder of radius 45 mm with a span of 500 mm and a 10 deg wedge are used. Two different freestream conditions with burst pressures of around 50 and 100 MPa are available. Freestream total enthalpies are around 20 MJ/kg and Mach numbers are approximately 9 for both conditions; air is used as the test gas. The cylinder is equipped with 17 pressure transducers and 17 thermocouples. For all tests holographic interferograms are obtained and, for some tests Schlieren pictures are also available. The experimental results are presented and compared to computations. Additionally the ideal dissociating gas model of Lighthill has been used to predict pressure and heat transfer rates on the body surface. A comparison between experimental, numerical and theoretical pressure and heat transfer loads is presented. Fairly good agreement is achieved. The influence of the chemical dissociation reactions are mainly seen to reduce the length scales of the flow. The experiments as well as the calculations of the Edney type IV interaction show unsteady flow behavior. An approximate Strouhal number of about 0.79 for the experiment and 1.02 for the calculation is determined.
Author (AIAA)
Shock Wave Interaction; Shock Tunnels; Nonequilibrium Flow; Heat Transfer Coefficients; Unsteady Flow

19980055982

Planar Laser Imaging of high speed cavity flow dynamics

Unalmis, O. H., Texas, Univ., Austin, USA; Clemens, N. T., Texas, Univ., Austin; Dolling, D. S., Texas, Univ., Austin; Jan. 1998; In English

Contract(s)/Grant(s): F49620-97-1-0060

Report No.(s): AIAA Paper 98-0776; Copyright; Avail: Aeroplus Dispatch

Simultaneous Planar Laser Scattering (PLS) imaging and fluctuating pressure measurements have been made for a rectangular cavity in a Mach 5 turbulent boundary layer. Preliminary results are presented in the form of instantaneous side view images, and power spectra for cavity length-to-depth ratios of 3, 4, 6, 7, and 8. High-frequency response pressure transducers were installed in the rear and front walls of the cavity to monitor the shear layer impingement at the top of the rear wall, and to determine the

upstream propagation time of acoustic waves from space-time-correlations. Instantaneous side view PLS images show the impingement shock and expansion waves, whereas the large turbulent structures at the outer edge of the shear layer mask the deflection of the shear layer into the cavity, even for the largest cavity tested. Preliminary analysis of the fluctuating pressure data suggests that the shock frequencies and the duration of the impingement shock are not sensitive to cavity length-to-depth ratio.
Author (AIAA)
Turbulent Boundary Layer; Cavity Flow; Wind Tunnel Tests; Pressure Measurement; Pressure Oscillations

19980055984

Numerical study of hypersonic rarefied-gas flows about a torus

Riabov, Vladimir V., Daniel Webster College, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0778; Copyright; Avail: Aeroplus Dispatch

Hypersonic rarefied-gas flows near a torus have been studied numerically by the direct simulation Monte-Carlo technique under the transitional flow-regime conditions at Knudsen numbers from 0.0167 to 1. The strong influence of the geometrical factor (the inner-outer-radii ratio) and the Knudsen number on the flow structure about a torus (the shape of shock waves, the stagnation-point location) and on skin friction, pressure distribution and drag have been found.
Author (AIAA)
Rarefied Gas Dynamics; Hypersonic Flow; Toruses; Transition Flow; Shock Wave Profiles

19980055985

Effects of surface heating on instabilities in a supersonic nozzle boundary layer

Brogan, Tory, Montana State Univ., Bozeman, USA; Demetriades, Anthony, Montana State Univ., Bozeman; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0779; Copyright; Avail: Aeroplus Dispatch

The effects of surface heating were explored in a two-dimensional Mach 3 DeLaval nozzle to identify transition mechanisms related to heat transfer. Earlier work demonstrated that when surface heating was applied to the nozzle throat, the boundary layer at the nozzle exit could be changed from laminar to turbulent with low levels of surface heating. The present experiments show that the effect of surface heating is to reduce low-frequency disturbance growth and amplitude in the first 70 percent of the nozzle length. Suppression of this low-frequency activity causes turbulent bursting to be moved downstream, thereby increasing the extent of laminar flow to nearly the entire nozzle length. A mechanism for transition delay could not be found with linear stability theory. Computations predict that surface heating has only a mild stabilizing effect on Gortler vortices and first mode Tollmien-Schlichting waves show negligible amplification within the nozzle. Calculations of the mean-flow also showed that neither natural cooling nor surface roughness could be responsible for the observed transition delay.
Author (AIAA)
Supersonic Nozzles; Aerodynamic Heating; Supersonic Boundary Layers; Boundary Layer Stability; Solid Surfaces; Aerodynamic Heat Transfer

19980055987

Leading-edge roughness as a transition control mechanism

Saric, William S., Arizona State Univ., Tempe, USA; Carrillo, Ruben B., Jr., Honeywell Commercial Avionics Systems, USA; Reibert, Mark S., Mystech Associates, Inc., USA; Jan. 1998; In English
Contract(s)/Grant(s): NCC1-194
Report No.(s): AIAA Paper 98-0781; Copyright; Avail: Aeroplus Dispatch

Low-turbulence freestream flows and stationary crossflow waves are explored in order to elucidate leading-edge roughness as a transition control mechanism. Nonlinear interaction and amplitude saturation are examined. It is found that, in the absence of artificial roughness, transition occurs before the pressure minimum at x/c of 0.71 for Re(c) of 2.4 x 10 exp 6. Adding k = 6-micron roughness with a spanwise spacing equal to (or a multiple of) the wavelength of the linearly most unstable wave (12 mm) moves transition forward to x/c of not more than 0.52. The subcritical forcing at 8-mm spanwise spacing actually delays transition beyond the pressure minimum and onto the trailing-edge flap at x/c of 0.80.
AIAA
Leading Edges; Surface Roughness; Transition Flow; Swept Wings

19980055988

Boundary-layer transition detection and structure identification through surface shear-stress measurements

Chapman, Keith L., Arizona State Univ., Tempe, USA; Reibert, Mark S., Arizona State Univ., Tempe; Saric, William S., Arizona State Univ., Tempe; Glauser, Mark N., Clarkson Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG2-724

Report No.(s): AIAA Paper 98-0782; Copyright; Avail: Aeroplus Dispatch

Several surface shear-stress measurements are made using hot-film sheet anemometry technology in a 3D, swept-wing boundary layer. Various measurements in the crossflow and streamwise directions are made in regions on the wing surface upstream, through, and downstream of the transition region from laminar to turbulent flow. Advanced analysis techniques including proper orthogonal decomposition (POD), spectra, and spatial correlations are used to identify the presence of flow structure and spatial evolutions within the measured surface shear-stress fields. The resulting spatial eigenmodes from the POD solution across the transition front presents a completely objective method for identifying the start and finish of the transition process in the swept-wing boundary layer. The crossflow POD solutions reveal certain transitional processes and spatial relationships important in understanding flow transition and in developing future flow control algorithms.

Author (AIAA)

Boundary Layer Transition; Shear Stress; Stress Measurement; Hot-Film Anemometers; Three Dimensional Boundary Layer; Swept Wings

19980055991

Knudsen and Mach number effects on the development of wake instabilities

Bird, G. A., GAB Consulting Pty., Ltd., Australia; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0785; Copyright; Avail: Aeroplus Dispatch

A computational study using the direct simulation Monte Carlo method is conducted for the development of the 2D flow over a vertical plate that is inserted into a uniform flow at zero time. A plane of symmetry was not imposed; a major objective was to study the spontaneous breakdown of flow symmetry in the wake. At a Mach number of 0.5, some asymmetry develops when the Knudsen number based on the full height of the plate falls below 0.01. A further increase in density by 50 percent causes this asymmetry to develop into periodic vortex shedding. This is similar to the vortex street that is seen at similar Reynolds numbers but lower Knudsen numbers in very low speed flows, although the vortices decay more rapidly at the higher Knudsen numbers. The wake becomes more stable as the freestream Mach number increases to sonic and supersonic values. The time-averaged flow over one period of the oscillation is similar to the stable vortex that is observed when flow symmetry is imposed. Vortex shedding has been found to occur under more rarefied conditions than would have been expected, and the study shows the importance of making computations with a time-accurate code.

Author (AIAA)

Knudsen Flow; Mach Number; Wakes; Two Dimensional Flow; Subsonic Flow; Flow Stability

19980056002

Dynamics of planetary probes - Design and testing issues

Chapman, Gary T., Eloret Inst., USA; Yates, Leslie A., AerospaceComputing, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0797; Copyright; Avail: Aeroplus Dispatch

Interest in planetary probes has increased significantly in the last few years. Many of the proposed missions will use aeroassist for the capture and descent phases of the missions. This use of aeroassist will put a greater demand on having accurate aerodynamics for these vehicles. Reviews are presented of some of the aerodynamic requirements, with particular emphasis on dynamic stability as well as the aerodynamic testing requirements, and with particular attention on the use of the ballistic range.

Author (AIAA)

Space Exploration; Space Probes; Aeroassist; Aerodynamic Characteristics; Dynamic Stability; Atmospheric Entry; Ballistic Ranges; Ground Tests

19980056003

A numerical and experimental investigation of generic space probes

Berner, C., Saint-Louis, French-German Research Inst., France; Winchenbach, G. L., USAF, Research Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0798; Copyright; Avail: Aeroplus Dispatch

A computational and experimental investigation of hemispheric space probes was conducted at low supersonic Mach numbers to investigate the flight performance with priority to the dynamic stability characteristics and to validate a 3D CFD code. Two

configurations representative of a generic entry space probe were tested in an aeroballistic range facility; these differed only in geometry with respect to the base. Launch Mach numbers were varied from 3.2 to 2.0 with final Mach numbers ranging from 1.1 to 0.8. Typical aerodynamic data obtained after 6DOF analysis of the trajectories are presented. Pitch damping analysis showed that the tested configurations are dynamically unstable at low yaw levels but achieve dynamic stability at a limit cycle of about 12 to 15 deg. Computations were performed by means of a full 3D Navier-Stokes code. Free-flight results and CFD predictions are compared, and found to show very good agreement.
Author (AIAA)
Space Probes; Computational Fluid Dynamics; Hemispheres; Dynamic Stability; Supersonic Flight; Atmospheric Entry Simulation; Blunt Bodies

19980056004

Hypersonic blunt body flows in hydrogen-neon mixtures

Stalker, R. J., Queensland, Univ., Australia; Edwards, B. P., Queensland, Univ., Australia; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0799; Copyright; Avail: Aeroplus Dispatch

The use of hydrogen-neon gas mixtures for experimental simulation of inviscid hypersonic ionizing blunt body flows in hydrogen-helium atmospheres is considered. An existing approximate theory of blunt body similarity is employed, and it is found that the ionizing relaxation of hydrogen can be accommodated in that theory if the effect of ionization along streamlines is correlated by a binary reaction variable involving the hydrogen partial pressure. The correlation is identical for helium and neon, and is not influenced by the fraction of diluent. Thus, blunt body flows of hydrogen-helium mixtures can be simulated with hydrogen-neon mixtures of a different diluent fraction. The simulation is demonstrated by using experiments with a 60 percent hydrogen 40 percent neon mixture in a free piston nonreflected shock tunnel to obtain the shock shape on a hemispherically blunted cone entering the atmosphere of Uranus or Neptune.
Author (AIAA)
Hypersonic Flow; Blunt Bodies; Helium Hydrogen Atmospheres; Neon; Gas Mixtures; Atmospheric Entry Simulation; Space Probes; Space Exploration; Gas Giant Planets

19980056034

Stagnation-point heat transfer rates for Pioneer-Venus probes

Park, Chul, Tohoku Univ., Japan; Ahn, Hyo-Keun, Tohoku Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0832; Copyright; Avail: Aeroplus Dispatch

The convective and radiative heat transfer rates are calculated for the stagnation region of the Pioneer-Venus Probe vehicles during their entry flights into the planet Venus. The nonequilibrium thermochemical state of the flow is calculated using a viscous shock layer method accounting for oxidation of heat-shield surface by atomic oxygen and for pyrolysis-gas injection. Radiative transport along the stagnation streamline is calculated using a line-by-line technique and tangent-slab approximation. For both radiative and convective heating rates, the present results are substantially smaller than the earlier values obtained assuming equilibrium.
Author (AIAA)
Radiative Heat Transfer; Stagnation Point; Pioneer Space Probes; Atmospheric Entry; Convective Heat Transfer; Venus Atmosphere

19980056035

CFD calculation of heat fluxes in turbulent flow for Pioneer-Venus probes

Ahn, Hyo-Keun, Tohoku Univ., Japan; Sawada, Keisuke, Tohoku Univ., Japan; Park, Chul, Tohoku Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0833; Copyright; Avail: Aeroplus Dispatch

The distribution of the turbulent convective heat transfer rate on the surface of the ablating heatshield of the Pioneer-Venus Day Probe is calculated using CFD. The Venusian atmosphere is assumed to consist of CO_2, and the shock layer is assumed to be in chemical nonequilibrium. Eleven chemical species are accounted for. The turbulence energy is calculated using a one-equation model accounting for the finiteness of turbulence energy at wall according the theory of Park (1984). The result shows that the convective heating rate decreases due to the injection at the stagnation point but increases greatly in the downstream region. This is in agreement with the Pioneer-Venus flight data.
Author (AIAA)
Computational Fluid Dynamics; Heat Flux; Turbulent Flow; Pioneer Space Probes; Convective Heat Transfer; Heat Shielding

19980056051

Unsteady calculation of slit flow with 2-D hybrid Euler/DSMC numerical approach

Roveda, Roberto, Texas, Univ., Austin, USA; Goldstein, David B., Texas, Univ., Austin; Varghese, Philip L., Texas, Univ., Austin; Jan. 1998; In English

Contract(s)/Grant(s): NAG9-804

Report No.(s): AIAA Paper 98-0852; Copyright; Avail: Aeroplus Dispatch

An adaptive computational technique that couples Nadiga's Adaptive Discrete Velocity (ADV) method with Bird's Direct Simulation Monte Carlo (DSMC) method has been used to analyze the unsteady jet evolution from a slit subject to a pressure differential. This work is motivated by the need to study thruster plume impingement on spacecraft solar panels. The method adaptively decomposes the domain according to the degree of local translational equilibrium that is quantified by appropriate breakdown parameters. Disconnected patches of DSMC solutions deform adaptively to track non-equilibrium regions of the flow. The approach allows one to resolve complicated transient flow structures through the concentration of a large number of DSMC particles in nonequilibrium regions. Simulations of the jet show that a weak shock wave initially propagates into the flow followed by the high density jet core. The flow accelerates through an expansion region bounded by two shear layers that form a characteristic 'barrel' structure. The behavior of the load as the jet strikes a target plate positioned seven slit heights downstream of the aperture is investigated.

Author (AIAA)

Unsteady Aerodynamics; Orifice Flow; Pressure Gradients; Equilibrium Flow

19980056058

Calculation of radiating flowfield behind a reflected shock wave in air

Sakai, Takeharu, Tohoku Univ., Japan; Sawada, Keisuke, Tohoku Univ., Japan; Park, Chul, Tohoku Univ., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0861; Copyright; Avail: Aeroplus Dispatch

A numerical method for calculating a 1D radiating flow field in a thermochemical equilibrium in which radiation strongly affects the flow field is developed. Radiative heat fluxes are calculated using a model developed earlier which combines Planck, Rosseland, and Gray-gas models. The flow solution is obtained with a fully implicit time-marching method using a full block matrix inversion. The method is applied for calculating a radiating flow fleld behind a reflected shock wave in air. It is shown that the method converges at enthalpies up to 100 MJ/kg and pressure up to 5 atm, and that the calculated radiative heat flux values agree fairly well with the experimental data taken at enthalpies of up to 80 MJ/kg.

Author (AIAA)

Flow Distribution; Air Flow; Heat Flux; One Dimensional Flow; Time Marching

19980056067

Turbulence structure of heat transfer through a pressure-driven three-dimensional turbulent boundary layer

Lewis, Douglas J., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Simpson, Roger L., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English

Contract(s)/Grant(s): AF-AFOSR-91-0310

Report No.(s): AIAA Paper 98-0871; Copyright; Avail: Aeroplus Dispatch

The structure of turbulent heat transfer in the well-documented pressure-driven 3D turbulent boundary layer generated by a wing-body junction was studied experimentally using a constant-current resistance thermometer and a fast response thin-layered surface heat flux gage. Simultaneous time-resolved surface heat flux and temperature profile measurements were taken in the spatially-developing 3D turbulent boundary layer upstream of the wing. Mean heat transfer was decreased by three-dimensionality. Mean temperature profiles showed logarithmic behavior but did not collapse on a law-of-the-wall profile. Statistical and spectral analysis of the temperature fluctuations and conditionally-averaged temperature traces provide information on changes to the near-wall turbulent structures. The strength of ejections from the near-wall region was decreased by three-dimensionality. The mean ejection frequency was unaltered by three-dimensionality. Time-delayed correlations of the surface heat flux and flow temperature revealed an initially linear turbulent wavefront whose inclination angle increases with three-dimensionality.

Author (AIAA)

Heat Transfer; Three Dimensional Boundary Layer; Temperature Measurement

19980056072

Real gas effects on the transition between regular and Mach reflections in steady flows

Gimelshein, S. F., Inst. of Theoretical and Applied Mechanics, Russia; Markelov, G. N., Inst. of Theoretical and Applied Mecha-

nics, Russia; Ivanov, M. S., Inst. of Theoretical and Applied Mechanics, Russia; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0877; Copyright; Avail: Aeroplus Dispatch

The impact of vibrational and chemical relaxation and flow rarefaction on the transition from regular to Mach reflection in steady supersonic flows is examined numerically with the direct simulation Monte Carlo method. Wedge-generated shock reflection in N-N2 gas is studied for M = 7.5 and Kn = 3.5 x 10 exp -4 and 9.0 x 10 exp -4 at fixed and moving wedges. Three different models of molecular collisions were considered; the first allows translation-rotation energy exchanges only, the second also takes account of molecular vibrations, and the third is the general case with translation-rotation-vibration exchanges and dissociation reactions. A significant influence of real gas effects both on regular and Mach reflections is shown, and a delay of regular-to-Mach reflection transition is observed.
Author (AIAA)
Real Gases; Mach Reflection; Steady Flow; Supersonic Flow

19980056084

Computational analysis of shock layer emission measurements in an arc-jet facility
Gokcen, Tahir, Thermosciences Inst., USA; Park, Chung S., Thermosciences Inst., USA; Newfield, Mark E., NASA Ames Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS2-14031
Report No.(s): AIAA Paper 98-0891; Copyright; Avail: Aeroplus Dispatch

This paper reports computational comparisons with experimental studies of a nonequilibrium blunt body shock layer flow in a high enthalpy arc-jet wind tunnel at NASA/Ames. The experimental data include spatially resolved emission spectra of radiation emanating from a shock layer formed in front of a flat-faced cylinder model. This investigation of arc-jet shock layer flows is a continuation of previous studies that considered the high pressure case of 83 torr stagnation point pressure. The present work focuses on the low pressure case of 27 torr stagnation point pressure. Multitemperature nonequilibrium codes are used to compute the conical nozzle flow, supersonic jet and shock layer flow. A line-of-sight radiation code is employed to predict the spectra from the computed flow field. Computed line-of-sight intensities are compared with the experimental data at several axial locations along the stagnation streamline. Line-of-sight averaged vibrational and rotational temperatures, deduced from the experimental spectra, are compared with computed results.
Author (AIAA)
Shock Layers; Blunt Bodies; Wind Tunnel Tests; Enthalpy; Emission Spectra

19980056085

Spectroscopic measurements of the flows in an arc-jet facility
Park, Chung S., NASA Ames Research Center, USA; Newfield, Mark E., NASA Ames Research Center, USA; Fletcher, Douglas G., NASA Ames Research Center, USA; Gokcen, Tahir, NASA Ames Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS2-14031
Report No.(s): AIAA Paper 98-0893; Copyright; Avail: Aeroplus Dispatch

Under two different test conditions, radiation emanating from the freestream and shock layer flow over a 15.24-cm diameter blunt-body test article was measured in the NASA Ames 20 MW Aerodynamic Heating Facility (AHF) Arc-jet. The test gas was a mixture of air and argon. Spatially resolved emission spectra were obtained over a 2000-8900-A wavelength range using a CCD camera (1024 x 256 array) attached to a spectrograph. Previously developed analytical tools were used to determine the following line-of-sight averaged thermodynamic properties from the calibrated spectra: rotational temperature of the freestream, and rotational and vibrational temperatures within the shock layer. Based on the variation in intensity of emission spectra along the stagnation streamline, the shock stand-off distance was determined. Two sets of data for each test condition were compared to evaluate the repeatability of the measurements. Considering likely sources of errors, an uncertainty analysis was performed to estimate the error bounds of the determined properties.
Author (AIAA)
Shock Layers; Blunt Bodies; Wind Tunnel Tests; Hypersonic Flow; Emission Spectra

19980056091

A review of the aerothermal characteristics of laminar, transitional, and turbulent shock/shock interaction regions in hypersonic flows
Holden, Michael, New York, State Univ., Buffalo, USA; Sweet, Shirley, Calspan Corp., USA; Kolly, Joseph, New York, State Univ., Buffalo; Smolinsky, Gregory, New York, State Univ., Buffalo; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0899; Copyright; Avail: Aeroplus Dispatch

We summarize the most important results from an extensive series of studies conducted over a range of Reynolds numbers from 100 to 10 exp 6 at Mach numbers from 6 to 18, to define the aerothermal loads generated in regions of shock/shock interaction from the rarefied flow to the fully continuum turbulent flow regimes. Detailed heat transfer and pressure measurements were made in the 48-inch, 96-inch and LENS shock tunnels with a series of cylindrical leading edges and spherical nosetips for a range of incident shock configurations, varying the Reynolds number by varying both model size and the unit Reynolds number of the freestream. Miniature high-frequency instrumentation was used to resolve the large heat transfer gradients and the flow unsteadiness observed in these studies. Heat transfer and pressure distributions typical of those found in laminar and low-density laminar transitional and turbulent shock/shock interaction regions are presented, together with correlations of the peak heating and pressure measurements made in these studies. Results from a preliminary study of real gas effects are also presented. The results of these studies are analyzed to provide guidance to predict the heating enhancement factors in laminar transitional and turbulent flow regimes.
Author (AIAA)
Aerothermodynamics; Laminar Flow; Transition Flow; Turbulent Flow; Shock Wave Interaction; Hypersonic Flow

19980056095

HSCT configuration design using response surface approximations of supersonic Euler aerodynamics

Knill, Duane L., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Giunta, Anthony A., Virginia Polytechnic Inst. and State Univ., Blacksburg; Baker, Chuck A., Virginia Polytechnic Inst. and State Univ., Blacksburg; Grossman, Bernard, Virginia Polytechnic Inst. and State Univ., Blacksburg; Mason, William H., Virginia Polytechnic Inst. and State Univ., Blacksburg; Haftka, Raphael T., Virginia Polytechnic Inst. and State Univ., Blacksburg; Watson, Layne T., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-1160; NAG1-1562
Report No.(s): AIAA Paper 98-0905; Copyright; Avail: Aeroplus Dispatch
A method has been developed to efficiently implement supersonic aerodynamic predictions from Euler solutions into a highly constrained, multidisciplinary design optimization of a High-Speed Civil Transport (HSCT) configuration. The method uses response surface (RS) methodologies, variable complexity modeling techniques, and coarse-grained parallel computing. Here, simple conceptual level aerodynamic models provide the functional form of the drag polar. Response surface models are created for the intervening functions (drag polar shape parameters) instead of for the drag itself. As a means to reduce the errors in the RS models of Euler solutions, optimization results using linear theory RS models are used to select the allowable ranges of the design variables. Then stepwise regression analysis, performed using linear theory aerodynamic results, provides information on the relative importance of each term in the quadratic RS models. With this information, reduced term RS models representing a correction to the linear theory RS model predictions are constructed using Euler solutions. Studies into 5, 10, 15 and 20 variable HSCT design problems show that accurate results can be obtained with the reduced term models at a fraction of the cost of creating the full term quadratic RS models.
Author (AIAA)
Supersonic Flow; Aircraft Configurations; Aircraft Design; Multidisciplinary Design Optimization

19980056099

Effects of sensitivity analysis on airfoil design

Eyi, S., Middle East Technical Univ., Turkey; Lee, K. D., Illinois, Univ., Urbana; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0909; Copyright; Avail: Aeroplus Dispatch
The effects of sensitivities on the performance of aerodynamic design optimization were evaluated. Sensitivities were obtained by both analytical and finite-difference approaches. A sensitivity code was developed to analytically obtain sensitivities for the 2D Euler equations using the material derivative concept of continuum mechanics. Several inverse design optimizations were performed to evaluate the merits of the analytical approach in comparison with the finite-difference approach. The results show that the analytical approach provides accurate sensitivities consistently, improves the convergence of design cycle, and hence reduces the design cost.
Author (AIAA)
Airfoils; Aircraft Design

19980056112

Validation of CFD methods for a boundary later ingesting inlet

Rodriguez, David L., Stanford Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0925; Copyright; Avail: Aeroplus Dispatch

The Blended-Wing-Body is a conceptual aircraft design with rear-mounted inlets that ingest boundary layer flow. Although ingesting this low-momentum flow can improve propulsive efficiency, poor inlet performance can offset and even overwhelm this potential advantage. Since CFD methods will be necessary to design and optimize these inlets, validation of these methods becomes the necessary first step. Experimental data recently made available on a semicircular duct have been used to validate a CFD method. A grid sensitivity study has been performed to determine the necessary grid density for an accurate simulation. Two advanced turbulence models have been tested and compared. Computed velocity profiles throughout the duct agree well with the experiments. Other critical inlet performance parameters such as pressure recovery and distortion are addressed, though not directly validated due to a lack of experimental data.
Author (AIAA)
Computational Fluid Dynamics; Proving; Body-Wing Configurations; Aircraft Design; Ingestion (Engines); Boundary Layer Flow

19980056113
Modeling of boundary condition for turbulent boundary layer bleed
Dambra, Shinsuke, Tokyo, Science Univ., Japan; Yamamoto, Makoto, Tokyo, Science Univ., Japan; Honami, Shinji, Tokyo, Science Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0926; Copyright; Avail: Aeroplus Dispatch

A new model of a boundary condition for bleed with porous holes is proposed. This model is based on the experimental evidence that the local bleed rate is primarily a function of the local flow conditions. We propose a model to simulate flow fields of a shock wave/turbulent boundary layer interaction with bleed at freestream Mach number of 2.5 with 6.0 and 8.0 deg shock generator angles. The computational results are compared with experimental data which contain wall static pressure and bleed flow rate distributions. It is shown that the agreement is improved by using our method for the bleed boundary condition.
Author (AIAA)
Boundary Conditions; Turbulent Boundary Layer; Bleeding

19980056114
Newton method on axisymmetric transonic flow and linearized 3D flow prediction
Ahn, Jon, Korea Inst. of Aeronautical Technology, Republic of Korea; Drela, Mark, MIT, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0928; Copyright; Avail: Aeroplus Dispatch

An axisymmetric transonic viscous flow analysis and design method has been developed by applying stream-surface based Newton method. This method incorporates a linearized three-dimensional flow prediction capability, using linear perturbations of the axisymmetric solution. Euler equations are coupled with axisymmetric integral boundary equations with two-dimensional closure and transition models. Stream-surface based finite volume formulations allow efficiency and useful design features. An actuator disk is used to model the fan disk inside a powered nacelle. A stream-surface grid generation scheme using a panel method has been developed to provide an adequate initial grid. Comparisons are made to analytic solutions and wind tunnel experiments of nacelles, resulting in good agreements. The algorithm shows fast convergence, typically within 10 iterations.
Author (AIAA)
Newton Methods; Axisymmetric Flow; Transonic Flow; Linearization; Three Dimensional Flow; Prediction Analysis Techniques

19980056115
3-D flow simulations for general powered engine nacelles using Euler equations
Li, Jie, Northwestern Polytechnical Univ., China; E, Qin, Northwestern Polytechnical Univ., China; Li, Fengwei, Northwestern Polytechnical Univ., China; Chen, Haixin, Northwestern Polytechnical Univ., China; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0929; Copyright; Avail: Aeroplus Dispatch

A simulation method based on the Euler equations has been developed for the analysis of a general powered engine, whose components include the outer cowl, inlet cowl, spinner, fan face, fan exit plane, and core cowl geometry. In a powered simulation, the mass flow ratio is prescribed at the fan face. The total pressure ratio, total temperature ratio and the bypass ratio are specified at the jet exit plane. The exhaust plume emerges naturally as part of the global solution. Comparisons of the numerical results with experimental data show very good agreement. It is shown that the solution of the Euler equations is well capable of simulating the powered engine flow field.
Author (AIAA)
Three Dimensional Flow; Computerized Simulation; Nacelles; Euler Equations of Motion; Engine Airframe Integration; Aircraft Engines

19980056116

Development of a second order upwind scheme with application to supersonic Euler flow

Kermani, M. J., Carleton Univ., Canada; Plett, E. G., Carleton Univ., Canada; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0930; Copyright; Avail: Aeroplus Dispatch

A second-order fully upwind scheme is developed and applied to the supersonic inviscid flow described by the Euler equations. The scheme is developed by combining the standard second- and third-order fully upwind schemes with appropriate weights of each as obtained by numerical experiments. Both the standard second- and third-order schemes require a flux limiter to bound the unwanted numerical oscillations, without which they are unable to achieve a machine accuracy of approximately O(10 exp -14) However, the current scheme requires no flux limiter for all the applied test cases and is demonstrated to be accurate, robust and to give non-oscillatory results, where it attains to machine accuracy. Agreement between the results of the current study and the results obtained from the classical theory of oblique shock is within an average error of 4 percent or better for all the cases examined.

Author (AIAA)

Upwind Schemes (Mathematics); Supersonic Flow; Inviscid Flow; Euler Equations of Motion; Incompressible Flow; Shock Waves

19980056117

Computational analysis of spatially-distributed thermal compression effects in supersonic flowfields

Haws, Richard G., Brigham Young Univ., USA; Daines, Russell L., Brigham Young Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS3-97020

Report No.(s): AIAA Paper 98-0931; Copyright; Avail: Aeroplus Dispatch

Distributed heat addition is studied using computational fluid dynamics for a low-contraction-ratio engine geometry as a means of improving high-Mach-number performance of fixed-geometry engines. Heat addition is distributed in two zones offset both axially and in a cross-stream direction, and results are compared with those of a conventional single-zone configuration. In the present geometry, two-zone heat addition increases specific impulse slightly over single-zone heat addition, despite limitations imposed by the geometry. Previous one-dimensional work showing a 61 percent increase in specific impulse for another geometry is verified. The current research provides a basis for further studies, and direction for future work is suggested.

Author (AIAA)

Spatial Distribution; Supersonic Flow; Compressible Flow; Heat Transfer; Computational Fluid Dynamics; Engine Design

19980056118

Viscous flow simulations in a transonic fan using k-epsilon and algebraic turbulence models

Yeuan, J. J., Feng Chia Univ., Taiwan, Province of China; Liang, T., Feng Chia Univ., Taiwan, Province of China; Hamed, A., Cincinnati, Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NSC-87-2212-E035-007

Report No.(s): AIAA Paper 98-0932; Copyright; Avail: Aeroplus Dispatch

A numerical solver for three-dimensional viscous flow simulations in turbomachines is developed and applied to calculate the flow field in an axial-flow transonic fan. The Navier-Stokes equations in a rotating frame of reference, and generalized body-fitted coordinates are solved using Pulliam's implicit diagonalized scheme. In the solver, the turbulence effects can be modeled using a two-equation low Reynolds number k-epsilon model, or the algebraic Baldwin-Lomax turbulence model. Results are presented for a transonic fan rotor, and compared to the experimental data obtained at NASA Lewis Research Center.

Author (AIAA)

Viscous Flow; Computerized Simulation; Transonic Flow; Fans; K-Epsilon Turbulence Model; Three Dimensional Flow

19980056119

Turbomachinery blade optimization using the Navier-Stokes equations

Chang, K. K., Illinois, Univ., Urbana, USA; Lee, K. D., Illinois, Univ., Urbana; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0933; Copyright; Avail: Aeroplus Dispatch

A method is presented to perform aerodynamic design optimization of turbomachinery blades. The method couples a Navier-Stokes flow solver with a grid generator and numerical optimization algorithm to seek improved designs for transonic turbine blades. A fast and efficient multigrid, finite-volume flow solver provides accurate performance evaluations of potential designs. Design variables consist of smooth perturbations to the blade surface. A unique elliptic-hyperbolic grid generation method is used to regenerate a Navier-Stokes grid after perturbations have been added to the geometry. Designs are sought which improve a design

objective while remaining within specified constraints. The method is demonstrated with two transonic turbine blades with different types and numbers of design variables.
Author (AIAA)
Turbomachinery; Turbine Blades; Optimization; Navier-Stokes Equation; Aerodynamic Configurations; Computational Fluid Dynamics

19980056120
Development and application of a CFD solver to the simulation of centrifugal compressors
Niazi, Saeid, Georgia Inst. of Technology, Atlanta, USA; Stein, Alex, Georgia Inst. of Technology, Atlanta; Sankar, L. N., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0934; Copyright; Avail: Aeroplus Dispatch

A three-dimensional unsteady compressible viscous flow solver has been developed, and applied to a low speed centrifugal compressor configuration. Good agreement with experiments have been obtained for a compressor tested at NASA Lewis Research Center. Comparisons with measured surface pressures, and performance data are given. For this compressor, stall was found to occur in the diffuser region. It is demonstrated that this stall may be eliminated, and stable operation may be restored by the use of bleed valves located on the diffuser walls.
Author (AIAA)
Computational Fluid Dynamics; Computerized Simulation; Centrifugal Compressors; Three Dimensional Flow; Unsteady Flow; Compressible Flow

19980056124
A study of recessed cavity flowfields for supersonic combustion applications
Baurle, R. A., Taitech, Inc., USA; Gruber, M. R., USAF, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0938; Copyright; Avail: Aeroplus Dispatch

The present study attempts to understand the cold flow characteristics of cavity flowfields for scramjet flameholding applications. Effects of cavity geometry, cavity length to depth ratio, and the incoming boundary layer were investigated. The effect of geometry shape on mass entrainment rates and residence times were minimal. In general, the length of the cavity determined mass entrainment characteristics, while the cavity depth essentially determined the cavity residence time. Results showed the standard two-equation turbulence models overpredicted the eddy viscosity, resulting in steady flowfields for all cavity geometries.
Author (AIAA)
Cavity Flow; Supersonic Combustion Ramjet Engines; Cold Flow Tests; Flame Holders

19980056125
Flow structure of supersonic flow past backward-facing step with perpendicular injector
Matsuo, Akiko, Keio Univ., Japan; Mizomoto, Masahiko, Keio Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0939; Copyright; Avail: Aeroplus Dispatch

Flow structures of supersonic flow past a backward-facing step with perpendicular injector are numerically investigated under the perfect gas condition in two-dimensional space. The incoming main flow is Mach number 2.5 and the injection is sonic jet, located 24mm behind the step. A step height (0, 2, 3, 6mm) and dynamic pressure ratio of the jet flow to the main flow (0.0, 0.2, 0.4, 0.6, 0.8, 1.0) are examined in the calculations. When the injector is far enough for the main flow to recover supersonic, the injection is independent of the effect of the backward-facing step. However, the jet interacts with the recirculation behind the step, the recirculation region expands to the jet. Once the recirculation region expands, the height of the recirculation region is closely related with the dynamic pressure ratio. The expansion waves from the step corner change to the compression wave when the height of the recirculation region becomes higher than the step height. For the step height 6mm, the unsteady oscillation appears in the flowfields. The mechanism of the oscillation is numerically clarified in the simulations.
Author (AIAA)
Flow Geometry; Supersonic Flow; Backward Facing Steps; Gas Injection; Ideal Gas; Two Dimensional Flow

19980056129
Computation of supersonic turbulent flowfield with secondary jet normal to freestream
Toda, Kaziyuki, Tokyo, Science Univ., Japan; Yamamoto, Makoto, Tokyo, Science Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0944; Copyright; Avail: Aeroplus Dispatch

Hypersonic propulsion research has been underway for many years to develop a hypersonic aircraft capable of flying at suborbital speeds, and the air-breathing supersonic combustion ramjet (scramjet) engine is a promising candidate for such an aircraft.

One of the critical elements in the design of a scramjet engine is thought to be the detailed understanding of a mixing process in the complex flowfield caused by the secondary injected flow. Steady flowfields resulting from slot injection at the surface of a flat plate in a freestream with a Mach number of 3.75 and unit Reynolds number of 1.65 x 10 exp 7/m are simulated, using the compressible mass-averaged Navier-Stokes equations and five typical turbulence models. The flowfields with various total pressure ratios of injection to freestream are computed, and comparisons are made with experimental data in terms of the surface total pressure distribution, the length of the upstream separation region, and the height of the Mach surface (i.e. penetration height). Two characteristics of model performances are clarified. Though the upstream separation length and the penetration height are differently predicted by each turbulence model, the correlation between them are nearly the same. A Reynolds stress model can reproduce the upstream separation region more reasonably than a k-epsilon model does, especially for high injection pressure cases.
Author (AIAA)
Supersonic Flow; Turbulent Flow; Jet Flow; Free Flow; Hypersonic Flow; Supersonic Combustion Ramjet Engines

19980056130
Experimental investigation of boundary layer ingesting diffusers of a semi-circular cross section
Anabtawi, Amer J., Southern California, Univ., USA; Blackwelder, Ron, Southern California, Univ., USA; Liebeck, Robert, Southern California, Univ., USA; Lissaman, Peter, Southern California, Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20275
Report No.(s): AIAA Paper 98-0945; Copyright; Avail: Aeroplus Dispatch
A fundamental experimental study on the flow characteristics of a diffusing semi-circular duct ingesting thick boundary layers has been performed. Pitot-static tube measurements provided total and static pressure readings at various cross sections of the duct, from which total pressure recovery and distortion descriptors were calculated at the duct exit (fan face). The effect of passive boundary layer control on improving inlet performance by use of vortex generators (VGs) of varying height, aspect ratio, and shape was investigated. Finally, boundary layer diverters were examined as alternatives to boundary layer ingestion in such circumstances. All V.G.s examined lowered the total pressure distortion to the 24-54 percent range, as compared with the base case of no boundary layer control distortion of 63 percent. However, not all VGs yielded better pressure recoveries than the base case where the total pressure loss coefficient varied between 17-21 percent as compared to 19 percent for the base case. The shape of the VG planform had a more pronounced effect for the larger VGs, with the delta VGs having the best overall performance. Acceptable boundary layer diversion was achieved with delta shaped planforms of height equal to boundary layer thickness, width equal to twice the throat, and length providing a sweep angle of at least 50 deg.
Author (AIAA)
Boundary Layer Flow; Flow Characteristics; Ingestion (Engines); Body-Wing Configurations

19980056131
A study of isolated nacelle flows at subsonic and transonic speeds
Humphries, P., Belfast, Queen’s Univ., UK; Gillan, M., Belfast, Queen’s Univ., UK; Raghunathan, S., Belfast, Queen’s Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0946; Copyright; Avail: Aeroplus Dispatch
A numerical investigation of the flow field associated with a generic isolated long duct nacelle is detailed. The computational fluid dynamics analysis was undertaken with a commercial Navier Stokes code. The elected code utilizes a fully explicit finite volume method to solve the time averaged Navier Stokes equations with a two equation turbulence model providing closure. As a result, simulation of the free shear layer flow associated with the exhaust flow and also calculation of all viscous terms involved with drag prediction are possible. The nacelle was considered as an isolated entity with all interference effects, such as wing upwash, neglected. All internal workings are eliminated with the nacelle test cases configured within the frame of a flow through nacelle. An arbitrary profile was substituted to represent the internal profile from the fan face to the nozzle with a thickness of quarter inch used for the nozzle exit. It is shown that the results yielded compare well with expected and validated profiles.
Author (AIAA)
Nacelles; Subsonic Speed; Transonic Speed; Flow Distribution; Computational Fluid Dynamics; Navier-Stokes Equation

19980056132
3-D Navier-Stokes simulation of turbulent afterbody/nozzle flows
Hamed, A., Cincinnati, Univ., USA; Yeuan, J. J., Feng Chia Univ., Taiwan, Province of China; Liang, T., Feng Chia Univ., Taiwan, Province of China; Liang, C. C., Feng Chia Univ., Taiwan, Province of China; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0947; Copyright; Avail: Aeroplus Dispatch

A numerical investigation was conducted to assess the performance of different turbulence models in the prediction of expandable supersonic flow fields and aerodynamic performance. The implicit numerical solution for the compressible Navier-Stokes equations was obtained for the afterbody/nozzle flow field including external free stream and plume interactions. Numerical results are presented for the axisymmetric flow in an overexpanded nozzle at freestream Mach numbers of 0.0 and 1.25, and for the three dimensional flow in a vented nozzle near design conditions at freestream Mach numbers of 0.0 and 2.5. Surface pressures, discharge coefficient, and thrust minus drag predictions are compared to existing experimental data.
Author (AIAA)
Navier-Stokes Equation; Three Dimensional Flow; Turbulent Flow; Afterbodies; Nozzle Flow; Baldwin-Lomax Turbulence Model

19980056134

Automated optimal design of two dimensional high speed missile inlets

Blaize, Michael, Rutgers Univ., USA; Knight, Doyle, Rutgers Univ., USA; Rasheed, Khaled, Rutgers Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): DABT63-93-C-0064
Report No.(s): AIAA Paper 98-0950; Copyright; Avail: Aeroplus Dispatch

A new methodology has been developed for automated optimal design of two dimensional high speed inlets. A semi-empirical flow solver and an improved Genetic Algorithm are linked within an automated loop. The purpose of this process is to maximize the total pressure recovery of the missile inlet: first of all, for one upstream flow condition, and secondly for an entire mission. This innovative design strategy allows great improvement of the original inlet design in a very short period of time. Successful results are presented from optimizations of inlets designed and tested at the Institute of Theoretical and Applied Mechanics (ITAM) in Novosibirsk, Russia. The significant improvements of the total pressure recovery, achieved by the Automated 0ptimization Loop, are verified using a full Navier-Stokes solver.
Author (AIAA)
Missiles; Intake Systems; Structural Design; Automation; Optimization

19980056135

Computational study of passive boundary layer control to a supersonic intake

Watterson, J. K., Belfast, Queen’s Univ., UK; Raghunathan, S., Belfast, Queen’s Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0951; Copyright; Avail: Aeroplus Dispatch

It has been proposed that passive boundary layer control technology could be applied to the problem of reducing the supersonic intake total pressure losses associated with the intake shock wave/boundary layer interaction. This paper reports the results of a numerical investigation of a possible realization of this idea. The passive bleed geometry tested had a wide suction slot inside the intake duct and a narrow tangential injection slot upstream of the intake entry, the slots being interconnected by a breather passage. Experiments have been conducted with a three dimensional intake model in a small supersonic tunnel at a Mach number of 1.36 and computational fluid dynamics calculations have been performed for a similar geometry, but reduced to two dimensions, in an effort to confirm the experimental results in the absence of the side-wall boundary layers. The results show that passive control can reduce the shock interaction losses at off design conditions. However, at intake design conditions the predicted total pressure losses increase. More work is necessary to determine the best passive control configuration.
Author (AIAA)
Boundary Layer Control; Supersonic Flow; Intake Systems; Turbojet Engines; Transonic Flow

19980056138

A moving grid capability for NPARC

Slater, John W., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0955; Copyright; Avail: Aeroplus Dispatch

Version 3.1 of the NPARC CFD flow solver introduces a capability to solve unsteady flow on moving multi-block, structured grids with nominally second-order time accuracy. The grid motion is due to segments of the boundary grid that translate and rotate in a rigid-body manner or deform. The grid is regenerated at each time step to accommodate the boundary grid motion. The flow equations and computational models sense the moving grid through the grid velocities, which are computed from a time-difference of the grids at two consecutive time levels. For 3D flow domains, it is assumed that the grid retains a planar character with respect to one coordinate. The application and accuracy of NPARC v3.1 is demonstrated for flow about a flying wedge, rotating flap, a

collapsing bump in a duct, and the unstart/restart flow in a variable-geometry inlet. The results compare well with analytic and experimental results.
Author (AIAA)
Computational Fluid Dynamics; Unsteady Flow; Computational Grids

19980056139
Implementation of an RNG k-epsilon turbulence model into version 3.0 of the NPARC 2-D Navier-Stokes flow solver
Papp, John L., Cincinnati, Univ., USA; Ghia, K. N., Cincinnati, Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NGT8-52801
Report No.(s): AIAA Paper 98-0956; Copyright; Avail: Aeroplus Dispatch

Recent developments in the area of Re-Normalization Group (RNG) methods have led to modified versions of the standard k-epsilon model which are more effective in capturing certain turbulent flow features, such as highly strained or rotating flows. The RNG k-epsilon model with a wall-function is implemented into NPARC, and its capabilities are assessed by comparison with experimental data and with the results generated using the currently available NPARC Chien k-epsilon model. The benchmark flow cases considered are the compressible mixing layer, the backward facing step, the turbulent flat plate, and the supersonic axisymmetric jet. The RNG model shows slight improvements for compressible mixing layer and axisymmetric jet flows. It is comparable to the existing NPARC Chien model for the backstep and turbulent boundary-layer flows. However, the implementation of a wall-function with the RNG model permits the accurate simulation of wall turbulence with greatly reduced near-wall grid resolution and thus represents an added benefit of the model.
Author (AIAA)
K-Epsilon Turbulence Model; Two Dimensional Flow; Navier-Stokes Equation; Three Dimensional Flow; Computational Fluid Dynamics

19980056140
Validations of CMOTT wall-functions module for NPARC
Yang, Z., AYT Corp., USA; Georgiadis, N., NASA Lewis Research Center, USA; Zhu, J., Allison Engine Co., USA; Shih, T. H., NASA Lewis Research Center, USA; Oyedirana, A., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0957; Copyright; Avail: Aeroplus Dispatch

The wall functions feature of the CMOTT turbulence module for NPARC is validated against some benchmark turbulent flows commonly found in propulsion systems. For each flow, results from the wall functions approach and results from low Reynolds turbulence model calculations are compared with the experimental data. Numerical aspects of the computations, such as code robustness, grid resolution requirement, computational cost, etc., are discussed. The present validation suggests that for many turbulent flows, the wall functions approach is prefered because it gives computational results which are comparable in accuracy to those obtained from the low Reynolds number turbulence model calculations, and yet uses only a fraction of the computer time.
Author (AIAA)
Proving; Wall Flow; Turbulent Flow; K-Epsilon Turbulence Model; Computational Fluid Dynamics

19980056141
Computation of crossing glancing shocks - Turbulent boundary layer interaction with bleed
Reddy, D. R., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0958; Copyright; Avail: Aeroplus Dispatch

A 3D viscous flow analysis is performed for a configuration where two crossing and glancing shocks interact with a turbulent boundary layer with bleed. A time-marching Reynolds-averaged Navier-Stokes code, NPARC, is used to compute the flow field, and the results are compared with experimental data obtained earlier in the NASA/Lewis 1 x 1 ft supersonic wind tunnel facility. A detailed comparison of Pitot pressure surveys, as well as surface static pressure distributions, for configurations with and without bleed is made in an effort to assess the predictive capability of the code for supersonic and hypersonic inlet applications.
Author (AIAA)
Turbulent Boundary Layer; Three Dimensional Flow; Viscous Flow; Navier-Stokes Equation; Bleeding

19980056143
Design of three-dimensional hypersonic inlets with rectangular to elliptical shape transition
Smart, M. K., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0960; Copyright; Avail: Aeroplus Dispatch

A methodology has been devised for the design of 3D hypersonic inlets which include a rectangular to elliptical shape transition. This methodology makes extensive use of inviscid streamtracing techniques to generate a smooth shape transition from a rectangular-like capture to an elliptical throat. Highly swept leading edges and a significantly notched cowl enable use of these inlets in fixed geometry configurations. The design procedure includes a 3D displacement thickness calculation and uses established correlations to check for boundary layer separation due to shock wave interactions. Complete details of the design procedure are presented, and the characteristics of a modular inlet with rectangular to elliptical shape transition and a design point of Mach 7.1 are examined. Comparison with a classical inlet optimized for maximum total pressure recovery indicates that this 3D inlet demonstrates good performance even well below its design point.
Author (AIAA)
Hypersonic Inlets; Three Dimensional Flow; Inlet Flow; Inviscid Flow

19980056145

Scramjet inlet flow computations by hybrid grid method

Kodera, Masatoshi, Tohoku Univ., Japan; Nakahashi, Kazuhiro, Tohoku Univ., Japan; Hiraiwa, Tetsuo, National Aerospace Lab., Japan; Kanda, Takeshi, National Aerospace Lab., Japan; Mitani, Tohru, National Aerospace Lab., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0962; Copyright; Avail: Aeroplus Dispatch

Computations of internal viscous flow fields of scramjet models were conducted at inflow Mach number of 5.4. An unstructured hybrid grid method was used to compute complex geometries such as scramjet models with a short strut. The numerical method to solve the Navier-Stokes equations on the hybrid grid was developed using a finite volume cell vertex scheme and the LU-SGS implicit time integration algorithm. The computational results using one-equation turbulence models showed good agreement with the experimental data. The flow features and the changes of flow fields due to the short strut located in the upper passage were discussed. It was found that a thick subsonic region did not exist in the combustor near the top wall at Mach number 5.4. With the strut, relatively low velocity regions became larger and the down wash flow toward the cowl behind the step became strong. The overconcentration of the fuel toward the top wall during the weak combustion was found in the experiment. The computational time and the accuracy of the present method were at the same level as the conventional structured grid methods. Thus, the present method seemed to be very useful for analysis and design of high-speed propulsion engines.
Author (AIAA)
Supersonic Combustion Ramjet Engines; Inlet Flow; Computational Grids; Viscous Flow; Navier-Stokes Equation; K-Epsilon Turbulence Model

19980056146

Parallel numerical simulation of compressible free shear layers in a scramjet engine

Matsuo, Yuichi, National Aerospace Lab., Japan; Mizobuchi, Yasuhiro, National Aerospace Lab., Japan; Ogawa, Satoru, National Aerospace Lab., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0963; Copyright; Avail: Aeroplus Dispatch

This paper presents an accurate and reliable numerical method for simulating compressible free shear layers in a scramjet engine. Special attention is focused on the proper modeling effort of the turbulence and temperature fluctuation effect in the Reynolds-averaged simulations. As the specific turbulence model, a two-equation k-epsilon model is adopted instead of the widely-used algebraic model. to take the temperature fluctuation effect into account, a two-equation type transport model is solved, and the modified Arrhenius type reaction rate equation is used. Numerical simulation results for four types of flows typically found in a scramjet engine are shown, and detailed discussion is given about the prediction capability of our numerical code and the critical problems concerning free shear layers in a scramjet engine, such as the effect of flow compressibility on the free shear layer growth rate, key factors to affect the flame holding, and the effect of turbulence temperature fluctuation on the combustion process.
Author (AIAA)
Digital Simulation; Compressible Flow; Shear Layers; Supersonic Combustion Ramjet Engines; Reusable Launch Vehicles; Computational Fluid Dynamics

19980056149

Quasi-3 dimensional analysis and design of turbomachinery blades

Ekici, Kivanc, Middle East Technical Univ., Turkey; Akmandor, I. S., Middle East Technical Univ., Turkey; Cetinkaya, Tahsin, Middle East Technical Univ., Turkey; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0966; Copyright; Avail: Aeroplus Dispatch

A quasi-3D analysis and design algorithm has been written for the preliminary prediction of the turbomachinery blade shapes. A duct flow solver in the meridional plane and a blade-to-blade solver in the tangential plane have been solved successively. The radial equilibrium of the flow at the inlet and exit of the cascade is established through a fourth-order accurate Runge-Kutta duct-flow solver. The blade-to-blade solver is a 2D transonic steady Euler-boundary layer coupled algorithm which uses a self-adapting streamline grid, a second-order accurate cell-face centered finite volume scheme, and the Newton-Raphson linearization technique. The solver capability is illustrated by the quasi-3D preliminary design of a R030 blade row. The code computational accuracy has also been tested against theoretical results of the Gostelow cascade.
Author (AIAA)
Turbine Blades; Structural Design; Three Dimensional Models; Two Dimensional Boundary Layer; Ducted Flow

19980056150
Total unsteadiness analysis for an axial-flow compressor rotor
Liu, B., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Moore, J. G., Virginia Polytechnic Inst. and State Univ., Blacksburg; Moore, J., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-1801
Report No.(s): AIAA Paper 98-0967; Copyright; Avail: Aeroplus Dispatch
The total unsteadiness downstream of an axial compressor rotor was studied computationally using a 3D Navier-Stokes solver. In the mean flow direction, the total unsteadiness was calculated, and comparisons were made at the rotor exit with the experimental data. Based on a more general definition of total unsteadiness in any direction, the total unsteadiness in the direction normal to the mean flow and in other directions is also discussed. The calculation results show that both the turbulence kinetic energy and the wake velocity deficit make important contributions to the total unsteadiness downstream of the rotor. The good agreement at the rotor exit between the calculated and the measured total unsteadiness suggests that steady flow Navier-Stokes codes with two-equation turbulence models can be useful tools for studying the flow unsteadiness in axial-flow turbomachinery.
Author (AIAA)
Turbocompressors; Unsteady Flow; Three Dimensional Flow; Navier-Stokes Equation; Rotors

19980056151
Calculation of multistage turbomachinery using steady characteristic boundary conditions
Chima, Rodrick V., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0968; Copyright; Avail: Aeroplus Dispatch
A multiblock Navier-Stokes analysis code for turbomachinery has been modified to allow analysis of multistage turbomachines. A steady averaging-plane approach was used to pass information between blade rows. Characteristic boundary conditions written in terms of perturbations about the mean flow from the neighboring blade row were used to allow close spacing between the blade rows without forcing the flow to be axisymmetric. In this report the multiblock code is described briefly, and the characteristic boundary conditions and the averaging-plane implementation are described in detail. Two approaches for averaging the flow properties are also described. A 2D turbine stator case was used to compare the characteristic boundary conditions with standard axisymmetric boundary conditions. Differences were apparent but small in this low-speed case. The two-stage fuel turbine used on the Space Shuttle main engines was then analyzed using a 3D averaging-plane approach. Computed surface pressure distributions on the stator blades and endwalls and computed distributions of blade surface heat transfer coefficient on three blades showed very good agreement with experimental data from two tests.
Author (AIAA)
Turbomachinery; Boundary Conditions; Navier-Stokes Equation; Pressure Distribution; Space Shuttle Main Engine

19980056152
Computation of turbomachinery flow by a convective-upwind-split-pressure (CUSP) scheme
Liu, Feng, California, Univ., Irvine, USA; Jennions, Ian K., ABB Power Generation, Ltd., Switzerland; Jameson, Antony, Stanford Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NSF CTS-94-10800
Report No.(s): AIAA Paper 98-0969; Copyright; Avail: Aeroplus Dispatch
An artificial dissipation scheme using the concepts of SLIP and CUSP is implemented on top of a baseline 3D turbomachinery flow code. The original baseline code uses a finite-volume method for the Navier-Stokes equations with classical Jameson-Schmidt-Turkel (JST) scalar dissipation scheme. This paper focuses on the comparison of the performance of the CUSP scheme

with the original JST scheme for turbomachinery flow calculations. The results show that the CUSP scheme is more reliable than the JST scheme and is capable of providing accurate loss predictions on relatively coarse grids.
Author (AIAA)
Turbomachinery; Upwind Schemes (Mathematics); Three Dimensional Flow; Supersonic Flow; Cascade Flow; Navier-Stokes Equation

19980056153

Unsteady flow interaction inside a high-Reynolds-number, axial-flow pump stage

Lee, Yu-Tai, U.S. Navy, Naval Surface Warfare Center, USA; Hah, Chunill, NASA Lewis Research Center, USA; Loellbach, James, NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0970; Copyright; Avail: Aeroplus Dispatch

Two numerical methods are used to examine the stator-rotor interaction in a pump configuration. A 2D unsteady inviscid panel/Euler hybrid method is used to efficiently calculate potential flow interactions between blade rows and is widely used for design applications in which viscous effects are negligible. A 3D, unsteady, Navier-Stokes method is used to resolve the total flow interaction, including both potential and viscous effects. The results from the two methods are examined in order to understand the flow interaction at mid-span. Both the hybrid, inviscid method and the 3D, viscous method calculate large unsteady pressure responses on the upstream stator blades. For the downstream rotor blades, the hybrid method calculates small unsteady pressure responses, while the viscous method predicts much larger unsteady pressure responses. Detailed examination of the calculated flow field indicates that flow separation and resulting vortex shedding at the rotor trailing edge are responsible for the large unsteady pressure response on the rotor blades.
Author (AIAA)
Unsteady Flow; High Reynolds Number; Axial Flow Pumps; Interactional Aerodynamics; Two Dimensional Flow; Inviscid Flow

19980056154

Active control of compressor rotating stall using linear amplitude feedback

Makropoulos, Nikos, Georgia Inst. of Technology, Atlanta, USA; Meumeier, Yedidia, Georgia Inst. of Technology, Atlanta; Prasad, J. V. R., Georgia Inst. of Technology, Atlanta; Zinn, Ben T., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0971; Copyright; Avail: Aeroplus Dispatch

This paper clarifies several issues that have been overlooked and misinterpreted in previous literature related to the active control of compressor rotating stall. This is accomplished via a complete, analytical, local stability analysis of the rotating stall inception point and the locally branched axisymmetric and nonaxisymmetric equilibria. This analysis is based on the first-term Galerkin approximation of the Moore-Greitzer model and it is valid for an arbitrary compressor map and a parabolic throttle characteristic. The analysis is generically performed for a rather large class of throttle feedback control laws. Each such control law is proportional to the rotating stall amplitude, raised to a strictly positive feedback exponent. The proportionality constant is a nonnegative feedback gain. It is shown that linear feedback renders the rotating stall inception point and the neighboring nonaxisymmetric branch locally asymptotically stable for any value of the feedback gain.
Author (AIAA)
Active Control; Aerodynamic Stalling; Feedback Control; Compressors

19980056155

Three-dimensional flow measurements down-stream of an axial compressor rotor using a four-hole pressure probe

Vikatos, W., Birmingham, Univ., UK; Jadayel, O. C., Birmingham, Univ., UK; Ekerol, H., Birmingham, Univ., UK; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0972; Copyright; Avail: Aeroplus Dispatch

The 3D nature of the flow field behind an isolated low-speed axial compressor rotor was studied experimentally, using a four-hole pressure probe mounted in the relative frame. The pre-calibrated probe was a successful alternative to the more conventional five-hole probe as it performed the same task with fewer measurements. Pressure measurements were acquired in a plane downstream of the rotor by traversing the flow in both radial and tangential directions. The pressures were then transferred with a simple pneumatic arrangement to the absolute frame. Three-dimensional blade-to-blade flow properties were calculated, from which an overall flow picture was obtained. The technique was successful in accurately identifying the bulk of the secondary flows within the passage, as well as quantifying the losses in total pressure. Finally, the measurements were compared with corresponding results obtained using a three-hole probe in the absolute frame.
Author (AIAA)
Three Dimensional Flow; Turbocompressors; Pressure Sensors

19980056157

Development of a large-scale, transonic turbine blade cascade facility for aerodynamic studies of merging coolant-mainstream flows

Sajben, Miklos, Cincinnati, Univ., USA; Al-Sayeh, Amjad L., Cincinnati, Univ., USA; DiMicco, Russell G., Cincinnati, Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0974; Copyright; Avail: Aeroplus Dispatch

The present paper is a progress report on the development of a linear cascade of turbine blades for the experimental study of aerodynamic effects associated with film cooling. Primary interest is in the mixing of the coolant ejected from the blade with the mainstream. The cascade dimensions are large to provide maximum spatial resolution. The row contains four blades with 5.530-in. axial chord and 6.912-in. span. Nominal flow total turning angle is 130.6 deg. Exit Mach number range is 0.8-1.35, and Reynolds numbers range from 1 to 2 millions (based on passage throat dimension and inlet total conditions). A coolant supply system is developed to simulate coolant/mainstream density ratios up to 2, using mixtures of air and sulfur hexafluoride (SF6). A full-perimeter bleed slot upstream of the blades is used to remove the approach boundary layers from all four walls. Adjustable tailboards are used, with perforations and suction to minimize wave reflections. A three-prong wake probe will be used to determine the distributions of five flow properties in the exit region. The probe actuator design offers continuous streamwise and transverse positioning during run while retaining full optical access through endwall windows.

Author (AIAA)

Transonic Flow; Turbine Blades; Cascade Flow; Coolants

19980056169

Pressure investigation of the hypersonic 'Directed-Energy Air Spike' inlet at Mach number 10 with arc power up to 70 kW

Toro, P. G. P., Rensselaer Polytechnic Inst., USA; Myrabo, L. N., Rensselaer Polytechnic Inst., USA; Nagamatsu, H. T., Rensselaer Polytechnic Inst., USA; Jan. 1998; In English

Contract(s)/Grant(s): NCC8-112

Report No.(s): AIAA Paper 98-0991; Copyright; Avail: Aeroplus Dispatch

The use of thermal energy as a means of enhancing flight performance of blunt bodies at hypersonic speeds is investigated. The 'Directed-Energy Air Spike' (DEAS) inlet concept proposes the beamed transmission of concentrated energy forward of a moving vehicle in order to change the bow shock configuration from a detached normal (strong) shock wave to an oblique, parabolic-shaped (weak) shock wave. This new approach provides low aerodynamic drag and heating, and also deflects the oncoming air into an annular hypersonic inlet. The compressed inlet air can either be accelerated to produce thrust or decelerated to extract onboard electric power. A 6 in. diameter blunt body model was fabricated and pressure transducers are installed at its surface and equipped with 6 in. long slender plasma torch at the stagnation point. This model has been installed in the RPI 24 in. diameter Hypersonic Shock Tunnel and used to test the Directed-Energy Air Spike concept. Pitot pressures have been measured at the maximum diameter annular region of the blunt body. Surface pressure and pitot rake pressure surveys as well as the schlieren photographs will be presented for Mach number 10 up to 70 kW power at the tip of the spike.

Author (AIAA)

Hypersonic Vehicles; Pressure; Shock Tunnels; Aerospike Engines; Aircraft Models; Aerodynamic Drag

19980056203

Velocity measurement in a rotor wake interacting with a fixed wing

Reddy, U. C., Georgia Inst. of Technology, Atlanta, USA; Matos, C. M., Georgia Inst. of Technology, Atlanta; Mahalingam, R., Georgia Inst. of Technology, Atlanta; Funk, R. B., Georgia Inst. of Technology, Atlanta; Komerath, N. M., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1033; Copyright; Avail: Aeroplus Dispatch

The velocity field of a rotor-wing-flap configuration in low speed forward flight is measured using planar spatial correlation velocimetry (SCV). A pulsed copper vapor laser sheet is used to illuminate the seeded flow. Phase-resolved, ensemble-averaged velocity fields are extracted using SCV at several chordwise planes. The third component of velocity is numerically extracted by satisfying the continuity equation in this incompressible flowfield. Planar velocity fields under the retreating blade side of the rotor confirm surface pressure data showing a lateral shift of the wake towards the advancing-blade side due to flap deflection. The reconstruction of the spanwise component in several parallel planes on the RBS shows the expected development of an outward-flowing spanwise wall-jet profile near the wing surface. The rotation due to the rotor wake induces velocities towards the advancing blade side (ABS) seen nearer the rotor. Sources of error and spatial and temporal resolution issues are addressed. Despite the conflicting requirements for temporal resolution and accuracy, posed by the simple and inexpensive optical system, it is shown

that such three-dimensional periodic velocity field measurements can be performed over the large volumes characteristic of rotorcraft flowfields in a short time.
Author (AIAA)
Aircraft Wakes; Velocity Measurement; Rotor Blades; Fixed Wings; Wing Flaps

19980056426

Tunnel interference in unsteady post-stall experiments

Zhang, Wenhua, Nanjing Univ. of Aeronautics and Astronautics, China; Ding, Kewen, Nanjing Univ. of Aeronautics and Astronautics, China; Huang, Da, Nanjing Univ. of Aeronautics and Astronautics, China; Li, Zhiqiang, Nanjing Univ. of Aeronautics and Astronautics, China; Zhang, Qingli, Nanjing Univ. of Aeronautics and Astronautics, China; Chinese Journal of Aeronautics; Nov. 1997; ISSN 1000-9361; Volume 10, no. 4, pp. 247-254; In English; Copyright; Avail: Aeroplus Dispatch

The effect of the size of a delta wing relative to that of the test section on the vortex breakdown location over a delta wing oscillating in pitch to very high angles of attack was investigated experimentally using flow visualization. The unsteady wall pressure characteristics, such as delay, frequency were analyzed. An unsteady tunnel wall correction, applying influence functions in steady wall pressure correction method and unsteady wall pressure at the optimum points, was presented. Experimental examinations prove that the unsteady tunnel wall correction is desirable.
Author (AIAA)
Aerodynamic Stalling; Delta Wings; Vortex Breakdown; Airfoil Oscillations; Flow Visualization; Unsteady Flow

19980056452

Recent rotor CFD developments for preserving tip vortex structure

Tang, Lei, Maryland, Univ., College Park, USA; Baeder, James D., Maryland, Univ., College Park; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper outlines some recent advances in the reduction of the numerical diffusion of vorticity for rotor Euler/Navier-Stokes analyses. They include both the accuracy improvement of an Euler/Navier-Stokes solver and the enhancement of grid resolution by a solution-adaptive grid redistribution method. Numerical results for 2D vortex convection and airfoil-vortex interactions indicate that these methods can dramatically reduce the numerical diffusion of vorticity for rotor Euler/Navier-Stokes analyses.
Author (AIAA)
Rotor Blades; Blade Tips; Blade-Vortex Interaction; Airfoil Profiles

19980056453

Application of unstructured grid methodology to rotorcraft flows

Pandya, Mohagna J., Paragon Research, Inc., USA; Bhat, Maharaj, Paragon Research, Inc., USA; Parikh, Paresh, Paragon Research, Inc., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A computational flow solution procedure based on the unstructured grid system has been modified to analyze mutual interactions of fuselage/wing/rotor of a tilt rotor aircraft. This work explores the application of unstructured grid-based Euler technology to rotorcraft flow-field analysis. Initially, the method has been validated for a rotor and a rotorcraft fuselage in isolation as well as in conjunction. Subsequently, this computational procedure was applied for XV-15 aircraft in low speed vertical ascent conditions. These computations are based on Euler equations, and represent blade loads that are time and space averaged. The rotor is represented as a zero-thickness actuator disk which imparts uniform pressure jump to the fluid particles passing through it. Preliminary results indicate that the unstructured grid technology is well suited for the rapid analysis of such flow fields.
Author (AIAA)
XV-15 Aircraft; Computational Grids; Interactional Aerodynamics; Fuselages; Tilt Rotor Aircraft

19980056456

Computing nonlinear airfoil characteristics at high Mach numbers

Narramore, J. C., Bell Helicopter Textron, Inc., USA; Yen, Jing G., Bell Helicopter Textron, Inc., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation of the capability of current analysis codes to predict and correlate with measured airfoil characteristics above drag divergence Mach number is presented. The measured data were obtained from a 2D transonic wind tunnel test at the Ohio State University 6- x 22-inch facility. Computational results from both a transonic potential flow code with boundary layer and two Navier-Stokes codes are compared to the wind tunnel test data. Results indicate that the transonic potential flow code with boundary layer does not predict observed nonlinear characteristics, while Navier-Stoke methods provide accurate results. The

Navier-Stokes results also suggested modifications to the airfoil that completely eliminate any nonlinear characteristics. Further wind tunnel testing of the modified airfoil confirmed these predictions.
Author (AIAA)
Transonic Flow; Airfoil Profiles; Aerodynamic Characteristics; Mach Number; Potential Flow; Wind Tunnel Tests

19980056457

A tilt rotor tip-shape analysis using CFD

Hu, Hong, Hampton Univ., USA; 1997; In English

Contract(s)/Grant(s): DAAJ02-94-C-0032; Copyright; Avail: Aeroplus Dispatch

The TLNS3DR code is applied to a tilt rotor tipshape analysis under both nonrotating and hovering motions to study tip vortex formation and to further investigate the capability of the code in rotor analysis. A tilt rotor aircraft main blade is computationally investigated. Effects of tip shapes on tip vortex formation and aerodynamic forces are studied by replacing the blade tip planform with an Ogee-type tip planform, a subwing tip planform, and a 45-deg swept-tapered tip planform, respectively. Solutions in terms of the tip vortex characteristics and aerodynamic forces are presented. A comparative study of the computational results is made.
Author (AIAA)
Tilt Rotor Aircraft; Blade Tips; Blade-Vortex Interaction; Form Factors; Swept Wings; Aerodynamic Forces

19980056459

The development of an overset/hybrid method for rotorcraft applications

Bangalore, Ashok K., Flow Analysis, Inc., USA; Moulton, Marvin A., Flow Analysis, Inc., USA; Caradonna, Francis X., NASA Ames Research Center, USA; 1997; In English

Contract(s)/Grant(s): DAAJ02-96-C-0033; Copyright; Avail: Aeroplus Dispatch

This paper describes the development of an overset/hybrid computation scheme for the prediction of general rotor/wake flows. The method combines a viscous flow solver near the blade surface with a vorticity embedding, potential method in the far field. The blade flow region is computed using a local hybrid method consisting of combined viscous and potential solvers that employ a body-fitted C-topology. The outer wake region is solved by a vorticity-embedding potential method that uses an H-topology. The blade and wake regions are coupled by oversetting. The overall approach is intended for application to all flight modes. Critical elements of the method are applied to unsteady flows and forward flight. Computations shown include the applications of hybrid and hybrid/overset methods to hover. An unsteady isolated blade hybrid method utilizing an external wake inflow model is applied to advancing rotors. An unsteady overset method is employed to solve the near blade aerodynamics, as well as the far-field wake of a four-bladed rotor in forward flight. The overset method is applied to the classical pitching and plunging airfoil problems in order to assess moment prediction capability.
Author (AIAA)
Helicopter Wakes; Viscous Flow; Unsteady Aerodynamics; Vorticity

19980056462

Active optimal control of blade vortex interactions

Yi, S. Y., Georgia Inst. of Technology, Atlanta, USA; Bae, S. H., Georgia Inst. of Technology, Atlanta; Prasad, J. V. R., Georgia Inst. of Technology, Atlanta; Sankar, L. N., Georgia Inst. of Technology, Atlanta; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper considers the development of approximate state space models for predicting unsteady airload fluctuations due to blade vortex interaction (BVI) and combining such models with optimal control theory to investigate optimal control strategies for reduction of BVI effects. A 2D finite-state model has been developed and validated by comparing the predicted steady and unsteady aerodynamic results with those from a CFD model previously developed at Georgia Tech for analyzing the BVI problem. The finite-state model has been combined with optimal control theory to arrive at optimal open loop flap schedules required for reducing BVI effects. Simulation results are presented to illustrate the influence of penalty weights on the resulting optimal control solutions.
Author (AIAA)
Unsteady Aerodynamics; Blade-Vortex Interaction; Active Control; Aerodynamic Loads; Optimal Control; Two Dimensional Models

19980056487

An experimental investigation of a loaded blade interacting with single and twin vortices

Masson, C. A., Glasgow, Univ., UK; Green, R. B., Glasgow, Univ., UK; Galbraith, R. A., Glasgow, Univ., UK; Coton, F. N., Glasgow, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Presented in this paper are the preliminary results from a blade vortex interaction (BVI) test series conducted in the University of Glasgow 1.61 x 2.13-m, closed return, low speed wind tunnel, in which a single vortex interaction with a rigid, loaded rotor blade was studied. The phenomena associated with the interaction of a vortex pair with an unloaded blade (twin BVI) are also discussed. The paper presents blade surface pressure data recorded at 72 pressure transducers located in the outer regions of the blade during these interactions. Integrated Cn and Cm((1/4) data are also presented to provide a detailed history of a BVI event. In addition, a method of isolating the bound circulation and vortex induced effects is presented, from which it is concluded that for a BVI event the vortex-induced effects are to a first approximation independent of rotor pitch setting. Preliminary results also indicated reductions in the recorded variations of Cm(1/4) and Cn during the twin BVI. The feasibility of studying a twin BVI event at the Glasgow facility is also demonstrated.

Author (AIAA)

Blade-Vortex Interaction; Aerodynamic Loads; Low Speed Wind Tunnels; Wind Tunnel Tests; Pressure

19980056494

Measurement of vortex strength and core diameter in the wake of a hovering rotor

Wadcock, Alan J., Sterling Software, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Detailed hot wire measurements were acquired in the tip vortex of a three-bladed model tilt-rotor in hover. Testing was conducted at a rotor tip speed of 752 ft/s corresponding to a Reynolds number (based on blade tip chord) of 1.77 x 10 exp 6 at thrust coefficients up to 0.0160. Strobed shadowgraph flow visualization was used to define the vortex trajectory as an aid in sensor positioning. Unlike previous hot wire studies which analyzed individual velocity profiles, average velocity profiles are computed from an ensemble of vortex signatures. The only velocity signatures analyzed were those corresponding to passage of the probe directly through the center of the vortex. These time histories were ensemble averaged after compensating for jitter in the vortex arrival time at the probe. The result is a smooth velocity profile that retains the core structure and permits the estimation of both vortex strength and vortex core diameter. The distinguishing feature of this data set is therefore that these measurements are essentially uncontaminated by ’vortex wander’. Raw hot wire data are presented for a typical test condition, and the method for deducing the translation speed of the vortex filament illustrated. The resulting tangential velocity distribution is presented, and the vortex core diameter and vortex strength determined.

Author (AIAA)

Rotor Aerodynamics; Vortices; Flow Visualization; Tip Speed

19980056495

Wake model requirements for prediction of BVI airloads

Wachspress, Daniel A., Continuum Dynamics, Inc., USA; Quackenbush, Todd R., Continuum Dynamics, Inc., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Wake model requirements for predicting the higher harmonic airloads associated with blade-vortex interaction (BVI) noise are investigated using the RotorCRAFT/AA (RCAA) computer code. The RCAA code models the vortex wake with freely-distorting, curved vortex filaments that are released across the full span of the rotor blade. A flow-field reconstruction technique is used to obtain accurate wake-induced velocity for azimuthal steps of a degree or less. RCAA is used to predict the HF, unsteady airloads associated with blade-vortex interaction (BVI) noise measured on the 40 percent scale BO-105 main rotor in the Higher Harmonic Control Aeroacoustic Rotor Test (HART) performed at the German-Dutch Wind Tunnel (DNW). The higher harmonic content of the airloads associated with BVI noise present in the BO-105 data is reasonably well-predicted by the analysis. Wake modeling parameters are varied to assess their importance to the prediction. The advantages of using a full-span, free wake model and an accurate representation of the wake roll-up are addressed.

Author (AIAA)

Aircraft Wakes; Blade-Vortex Interaction; Aerodynamic Loads; Noise Prediction (Aircraft); Rotor Blades; Vortex Filaments

19980056497

Unsteady aerodynamics of airfoils encountering traveling gusts and vortices

Leishman, J. G., Maryland, Univ., College Park, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Solutions are obtained for the unsteady lift and pitching moment on 2D airfoils penetrating into downstream and upstream traveling sharp-edged gusts. The approach makes use of the reverse flow theorems of aerodynamics. For the incompressible case,

exact results are given and are generalized numerically for any gust field by means of Duhamel superposition. Results are then obtained for the airloads and acoustics generated by a 2D airfoil encountering a vortex convecting at different gust speed ratios. Numerical results for the traveling sharp-edged gust problem are also derived for subsonic flows by means of exact linear theory. Further results for the subsonic case are computed by means of a Euler finite-difference method. It is found that the gust speed ratio has substantial effects on the unsteady airloads and will be an important parameter to represent in helicopter rotor aeroacoustic problems.
Author (AIAA)
Unsteady Aerodynamics; Airfoil Oscillations; Gust Loads; Vortices; Pitching Moments; Aeroacoustics

19980056499

A free-vortex rotor wake model for maneuvering flight

Bagai, Ashish, Maryland, Univ., College Park, USA; Leishman, J. G., Maryland, Univ., College Park; Park, Jacob, Maryland, Univ., College Park; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A free-vortex method is developed to model a rotor wake under maneuvering flight conditions. The numerical approach is based on a finite-difference approximation to the vorticity transport equation. This equation is solved using a pseudo-implicit relaxation method. It is shown that, in both hover and forward flight, maneuvers are a source of additional distortion to the vortical rotor wake. This wake distortion can be sensitive to the maneuvering rates. In hover and low speed forward flight, the maneuver-induced wake distortion is manifest as a counter intuitive change in inflow velocity through the rotor. This suggests that the free wake dynamics during pitching and rolling maneuvers at low advance ratios can be manifest as a significant contributor to the 'off-axis' blade flapping response. At higher advance ratios, the effects of maneuver-induced wake distortions are reversed, which suggests a more intuitive rotor flapping response will be obtained. In addition, it is shown that maneuvers can increase the likelihood of encountering blade vortex interactions.
Author (AIAA)
Aircraft Maneuvers; Rotor Blades; Blade-Vortex Interaction; Finite Difference Theory; Vorticity Transport Hypothesis; Aircraft Wakes

19980056500

Improved wake geometry model for a maneuvering rotor

Krothapalli, Krishnamohan R., Georgia Inst. of Technology, Atlanta, USA; Prasad, J. V. R., Georgia Inst. of Technology, Atlanta; Peters, David A., Washington Univ., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A generalized model for wake distortion in hover is developed using the exact relation derived from vertex tube theory. Additionally, a free wake analysis is performed to study the predicted wake curvature.
Author (AIAA)
Aircraft Wakes; Rotor Aerodynamics; Aircraft Maneuvers; Hilsch Tubes; Vortices

19980056777

Study of the unsteady flow features on a stalled wing

Yon, Steven A., San Diego State Univ., USA; Katz, Joseph, San Diego State Univ., USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 305-312; In English
Contract(s)/Grant(s): NCA2-786
Report No.(s): AIAA Paper 97-1927; Copyright; Avail: Aeroplus Dispatch

The occurrence of large-scale structures in the poststall flow over a rectangular wing at high angles of attack was investigated in a small-scale subsonic wind tunnel. Mean and time-dependent measurements within the separated flowfield suggest the existence of two distinct angle-of-attack regimes beyond wing stall. The shallow stall regime occurs over a narrow range of incidence angles (2-3 deg) immediately following the inception of leading-edge separation. In this regime, the principal mean flow structures, termed stall cells, are manifested as a distinct spanwise periodicity in the chordwise extent of the separated region on the model surface with possible lateral mobility not previously reported. Within the stall cells and on the wing surface, large-amplitude pressure fluctuations occur with a frequency much lower than anticipated for bluff body shedding and with minimum effect in the far wake. In the deep stall regime, stall cells are not observed, and the separated region near the model is relatively free of large-amplitude pressure disturbances.
Author (AIAA)
Unsteady Aerodynamics; Wing Oscillations; Aerodynamic Stalling; Subsonic Wind Tunnels; Unsteady Flow

19980056782

Predicting S-duct flow using a composite algebraic stress model

Jongen, T., Swiss Federal Inst. of Technology, Switzerland; Mompean, G., Swiss Federal Inst. of Technology, Switzerland; Gatski, T. B., NASA Langley Research Center, USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 327-335; In English; Copyright; Avail: Aeroplus Dispatch

An incompressible composite algebraic stress model is presented that accounts for dissipation rate anisotropies and that is validated against S-duct flow. The component algebraic stress and algebraic, anisotropic dissipation rate models have been developed previously and tested against homogeneous flow. The composite model is developed for integration to the wall and is calibrated against high-Reynolds number plane channel flow data to ensure the correct log-law behavior. The model is validated and analyzed against turbulent flow in an S duct. Both predicted mean flow quantities and turbulence statistics are compared with experimental data, as well as with an isotropic eddy viscosity model and an algebraic stress model with an isotropic dissipation rate. The experimentally observed lag between the shear stress vector direction and the mean velocity-gradient vector direction is qualitatively predicted. The effects of anisotropic dissipation rate on the production of the dissipation term in the dissipation rate equation and on the scalar functions that multiply the linear and nonlinear terms in the tensor expansion are examined relative to the algebraic stress formulation with an isotropic eddy viscosity.

Author (AIAA)

Ducted Flow; Reynolds Stress; Turbulent Flow; Isotropic Turbulence; Reynolds Averaging

19980056791

Experimental study of causes of unsteadiness of shock-induced turbulent separation

Unalmis, O. H., Texas, Univ., Austin, USA; Dolling, D. S., Texas, Univ., Austin; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 371-378; In English

Contract(s)/Grant(s): DAAL03-91-G-0023; NAG1-1471; Copyright; Avail: Aeroplus Dispatch

Simultaneous measurements have been made of the fluctuating wall pressures under the unsteady separation shock wave in a Mach 5 blunt fin-induced interaction and fluctuating pitot pressures from a triple-tipped probe placed well upstream in the undisturbed turbulent boundary layer. Results show a correlation between the scale of the separated flow and spanwise variations in pitot pressure in the incoming boundary layer. The low-frequency spanwise pitot pressure variations are consistent with earlier experiments, indicating the presence of a spanwise vortex structure in the incoming boundary layer. The results suggest that these vortices may be the cause, or at least one of the causes, of the low-frequency pulsation of the separated flow.

Author (AIAA)

Unsteady Aerodynamics; Wall Pressure; Pressure Oscillations; Turbulent Boundary Layer; Separated Flow

19980056795

Competing mechanisms of compressible dynamic stall

Chandrasekhara, M. S., U.S. Naval Postgraduate School, USA; Wilder, M. C., MCAT, Inc., USA; Carr, L. W., NASA Ames Research Center, USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 387-393; In English

Report No.(s): AIAA Paper 96-1953; Copyright; Avail: Aeroplus Dispatch

Earlier experiments have documented the onset of compressible dynamic stall either from the bursting of a leading-edge laminar separation bubble or from a leading-edge shock, depending on the Reynolds number and Mach number. For certain combinations of conditions, the supersonic flow and the bubble dynamics compete with each other. The consequent complex interactions lead to a newly discovered mechanism of dynamic stall onset. Details of these various mechanisms are discussed.

Author (AIAA)

Compressible Flow; Aerodynamic Stalling; Laminar Flow; Leading Edges; Separated Flow

19980056797

Study of passive control in a transonic shock wave/boundary-layer interaction

Bur, Reynald, ONERA, France; Corbel, Bernard, ONERA, France; Delery, Jean, ONERA, France; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 394-400; In English

Report No.(s): AIAA Paper 97-0217; Copyright; Avail: Aeroplus Dispatch

Passive control applied to a turbulent shock wave/boundary-layer interaction has been investigated by considering a two-dimensional channel flow. The field has been probed in great detail by using a two-component laser Doppler velocimetry system to execute mean velocity and turbulence measurements. Four different perforated plates have been considered along with the solid wall reference case. These measurements have shown that passive control deeply modifies the inviscid flowfield structure, the single shock being replaced by a lambda shock system. This modified compression induces a substantial reduction of the wave

drag associated with the interaction. On the other hand, the combined injection-suction effect taking place in the control region provokes an increase of the viscous drag, which nearly outbalances the reduction in wave drag. It was found that passive control induced a modest decrease of the total drag compared to the solid wall case. Moreover, the experimental wall transpiration velocity distribution in the control region is well represented by the usual laws.
Author (AIAA)
Interactional Aerodynamics; Transonic Flow; Flow Visualization; Laser Doppler Velocimeters

19980056799

Efficient computation of unsteady viscous flows by an implicit preconditioned multigrid method

Pierce, Niles A., Oxford, Univ., UK; Alonso, Juan J., Princeton Univ., USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 401-408; In English
Report No.(s): AIAA Paper 97-0444; Copyright; Avail: Aeroplus Dispatch

An implicit preconditioned multigrid algorithm is developed for the efficient solution of two-dimensional, low-frequency unsteady turbulent Navier-Stokes calculations on highly stretched meshes. The efficiency of the approach derives from three key attributes: (1) an implicit time discretization that allows the time step to be determined solely by the resolution requirements of the unsteady phenomena, (2) an inner preconditioned multigrid iteration that is explicit in pseudotime and rapidly convergent even in the presence of boundary-layer anisotropy, and (3) a compact stencil that is ideally suited for parallelization on distributed memory architectures. For fully resolved turbulent Navier-Stokes calculations of low-frequency pitching airfoils, the implicit discretization allows the use of time steps that are 10 exp 6 larger than are permissible with an explicit scheme. Convergence within the inner iteration is accelerated by a combination of block-Jacobi preconditioning and J-coarsened multigrid to yield computational savings of roughly an order of magnitude over existing methods that rely on the standard combination of scalar time stepping and full-coarsened multigrid.
Author (AIAA)
Unsteady Aerodynamics; Viscous Flow; Multigrid Methods; Aeroelasticity; Reacting Flow

19980056800

Model for rotor tip vortex-airframe interaction. III - Viscous flow on airframe

Affes, H., Ford Motor Co., USA; Xiao, Z., Ohio State Univ., Columbus; Conlisk, A. T., Ohio State Univ., Columbus; Kim, J. M., Georgia Inst. of Technology, Atlanta; Komerath, N. M., Georgia Inst. of Technology, Atlanta; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 409-415; In English; Copyright; Avail: Aeroplus Dispatch

The behavior of vortex systems in the vicinity of solid surfaces is a matter of intense interest in rotorcraft aerodynamics, as well as in many other areas of fluid dynamics. We consider the viscous flow on a simplified model of a helicopter airframe due to a helicopter rotor tip vortex both experimentally and computationally. As the tip vortex approaches the airframe, the computational results predict the genesis of a region just upstream of the main vortex, characterized by reversed flow and rapid growth in size. The experiments clearly show evidence of such a region under the tip vortex in the region predicted by the computations and at roughly the same time. The secondary vorticity field in the computations is of a sign opposite to the vorticity associated with the tip vortex. Results for the streamline patterns and vorticity field during the genesis of the secondary eddy are presented and compared with experimental flow visualization results.
Author (AIAA)
Airframes; Rotor Body Interactions; Blade Tips; Viscous Flow; Blade-Vortex Interaction; Rotary Wings

19980056817

Numerical viscous flow analysis around a high-speed train with crosswind effects

Park, Warn-Gyu, Pusan National Univ., Republic of Korea; Jung, Young-Rae, Pusan National Univ., Republic of Korea; Ha, Seong-Da, Korea Inst. of Machinery and Materials, Republic of Korea; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 477-479; In English; Copyright; Avail: Aeroplus Dispatch

Although the crosswind may significantly affect the longitudinal and lateral stability of a high-speed train, the details of the flow properties of the crosswind are not well understood. Here, an iterative time-marching scheme is applied to the incompressible turbulent flow around a high-speed train with cross-wind effects. The governing equations are implicitly discretized with a backward scheme for the time derivatives, the QUICK scheme for convective terms, and the central difference scheme for viscous terms. The Marker-and-Cell concept is used to efficiently solve the continuity equation. It is shown that the approach used here

provides a good simulation of turbulent flows around a high-speed train with crosswind effects at yaw angles of 0, 9.2, 16.7, and 45 deg.
AIAA
Viscous Flow; Aerodynamic Loads; Rail Transportation; High Speed; Unsteady Aerodynamics; Aerodynamic Noise

19980056820

Hybrid turbulence model for unsteady boundary layers

Greenblatt, David, Tel Aviv Univ., Israel; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 481-484; In English; Copyright; Avail: Aeroplus Dispatch

A hybrid model for unsteady boundary layers is developed which combines two inependently developed concepts into a single model. The model is tested on a streamwise fully developed large-amplitude pulsating turbulent pipe flow near separation, and the results are compared against experimental data. It is found that, although the model provides satisfactory near-wall predictions near separation, the extension of the current model to unsteady separating flows presents a problem. Two approaches for dealing with this problem are proposed.
AIAA
Turbulence Models; Aerodynamic Stalling; Pipe Flow; Turbulent Boundary Layer; Boundary Layer Separation; Unsteady Flow

19980056825

Mach reflection wave configuration in two-dimensional supersonic jets of overexpanded nozzles

Li, H., Negev, Univ., Israel; Ben-Dor, G., Negev, Univ., Israel; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 488-491; In English; Copyright; Avail: Aeroplus Dispatch

An analysis is made of the Mach reflection wave configurations and flowfields associated with two-dimensional supersonic free jets of overexpanded nozzles. An analytical model for calculating the height of Mach stem and the cell size of the jet is developed using the two- and three-shock theory along with the classical gasdynamic theory. The results obtained with the model proposed here are in reasonably good agreement with numerical calculations.
AIAA
Wave Reflection; Mach Reflection; Two Dimensional Flow; Supersonic Jet Flow; Convergent-Divergent Nozzles

19980056890

Explicit/implicit fluid/structure staggered procedures with a structural predictor and fluid subcycling for 2D inviscid aeroelastic simulations

Piperno, Serge, CERMICS, France; International Journal for Numerical Methods in Fluids; Nov 30, 1997; ISSN 0271-2091; Volume 25, no. 10, pp. 1207-1226; In English; Copyright; Avail: Issuing Activity

Field time integrators with second-order-accurate numerical schemes for both the fluid and the structure are considered for unsteady Euler aeroelastic computations. We show that if these schemes are simply coupled and used straightforwardly with subcycling, then accuracy and stability properties may be lost. We present new coupling staggered procedures where momentum conservation is enforced at the interface. This is done by using a structural predictor. Continuity of structural and fluid grid displacements is not satisfied at the fluid/structure interface. However, we show on a two-degree-of-freedom aerofoil that this new type of method has many advantages, e.g. accuracy of conservation at the interface and extended stability. The supersonic flutter of a flat panel is simulated in order to numerically prove that the algorithm gives accurate results with arbitrary subcycling for the fluid in the satisfying limit of 30 time steps per period of coupled oscillation.
Author (EI)
Inviscid Flow; Two Dimensional Models; Computational Fluid Dynamics; Computerized Simulation; Airfoils; Degrees of Freedom; Flutter

19980057371

Wind tunnel tests of wings at Reynolds numbers below 70,000

Laitone, E. V., California, Univ., Berkeley, USA; Experiments in Fluids; Nov. 1997; ISSN 0723-4864; Volume 23, no. 5, pp. 405-409; In English; Copyright; Avail: Aeroplus Dispatch

Rectangular planform wings were tested at Reynolds numbers as low as 20,000 in a low-turbulence wind tunnel. The lift and drag measurements on a NACA 0012 profile were compared with those for thin flat and cambered plates. For all Reynolds numbers below 70,000 the best profile was a thin plate with a 5 percent circular arc camber. At all turbulence levels this profile produced the greatest lift-drag ratio and had the highest lift coefficient at all angles of attack. The 5 percent camber and all of the thin

plates tested were relatively insensitive to either a variation in the Reynolds number or an increase in the wind tunnel turbulence level, whereas the NACA 0012 was very seriously affected by either at Reynolds numbers below 50,000.
Author (AIAA)
Rectangular Wings; Wind Tunnel Tests; Wing Planforms; Aerodynamic Forces; Lift Drag Ratio; Low Reynolds Number

19980057375

Near-wake measurement in a rotor/stator axial compressor using slanted hot-wire technique

Hsu, S. T., National Taiwan Univ., Taipei, Taiwan, Province of China; Wo, A. M., National Taiwan Univ., Taipei; Experiments in Fluids; Nov. 1997; ISSN 0723-4864; Volume 23, no. 5, pp. 441-444; In English
Contract(s)/Grant(s): NSC-85-2212-E002-040; Copyright; Avail: Aeroplus Dispatch

The 3D near-wake structure behind a rotor was measured using a slanted hot-wire technique in a large-scale, low-speed, rotor/stator axial compressor. Unsteady flow interaction between blade rows was varied by setting the axial gap between rows at 10 percent and 30 percent of rotor chord. Results show that stronger flow interactions between blade rows, or closer axial gap, produce more pronounced time variation within the rotor wake. All parameters measured - three component velocities, yaw, and pitch angles - varied strongly within the wake and are quantified.
Author (AIAA)
Near Wakes; Rotor Blades; Stator Blades; Hot-Wire Anemometers; Flow Measurement; Rotor Body Interactions

19980057506

Fundamentals of incompressible aerodynamics ***Fundamentos de aerodinamica incompressivel***

de Brederode, Vasco, Inst. Superior Tecnico, Portugal; 1997; ISBN 972-97402-0-8; Copyright; Avail: Aeroplus Dispatch

An account is given of the principles of low speed aerodynamics and their application to internal and external flows in both the laminar and the turbulent regimes. After presenting the fundamental concepts and equations of fluid mechanics, attention is given to vortex flows, laminar flows and the laminar-to-turbulent transition, fully turbulent flow and 3D boundary layers, incompressible potential flow, and flows characterizing airfoils, wings and bluff bodies. FORTRAN codes for modeling flow processes are furnished in a diskette together with sample input and output files.
AIAA
Airfoil Profiles; Incompressible Flow; Flow Equations; Turbulent Flow; Boundary Layer Transition; Laminar Flow

19980057765

Transonic flow over wavy walls - A new solution procedure compared with experiments

Narang, B. S., San Diego State Univ., USA; Ho, J., San Diego State Univ., USA; Aeronautical Journal; Dec. 1997; ISSN 0001-9240; Volume 101,, no. 1010, pp. 487-493; In English; Copyright; Avail: Aeroplus Dispatch

A new method has been used to solve the transonic flow equation for flow over a wavy wall. The results thus obtained are compared with those obtained from windtunnel experiments. A new fluctuating flow phenomenon has been observed both in the experiment and in numerical calculations which may enhance flow mixing. The numerical results also indicate that the flow becomes locally sonic for a transonic parameter value greater than 0.5, while experimental data indicate a value of 0.6363 for the transonic parameter. The classical value of the transonic parameter has a value of one for the flow to become locally sonic.
Author (AIAA)
Transonic Flow; Surface Roughness; Wall Flow; Flow Equations; Wind Tunnel Tests; Oscillating Flow

19980058140

An engineering calculating method of the aerodynamic load for long range rocket projectile wrap-around wings

Cheng, Yangmin, China Aerospace Corp., 4th Academy, 41st Inst., Xian, China; Journal of Solid Rocket Technology; Dec. 1997; ISSN 1006-2793; Volume 20, no. 4, pp. 1-6; In Chinese; Copyright; Avail: Aeroplus Dispatch

Using the rigid body ballistic equations, and considering a number of interference factors, the maximum aerodynamic load of the wrap-around wings is calculated in accordance with the aerodynamic characteristics of the wings. It is shown by the verification of samples that the calculated results by the method agree with flight test results.
Author (AIAA)
Aerodynamic Loads; Rockets; Winged Vehicles; Aerodynamic Interference; Projectiles

19980058191

Secondary and tip-clearance flows in axial turbines; Lecture Series, Rhode-Saint-Genese, Belgium, Feb. 10-13, 1997

1997; In English

Report No.(s): VKI-LS-1997-01@ISSN 0377-8312; Copyright; Avail: Aeroplus Dispatch

The present volume on secondary and tip-clearance flows in axial turbines discusses tip-clearance effects in axial turbines, the physics of tip-clearance flows, modeling of tip-clearance flows in axial turbines, and the physics of secondary flows. Attention is given to secondary flows and vorticity, secondary loss (loss generation, effect of blade design, and loss correlations and modeling), CFD modeling of secondary flows, and turbine blade tip/outer airseal/platform flow analysis. Other topics addressed include heat transfer aspects of secondary and tip clearance flows in axial turbines, full 3D turbine blade design, 3D Navier-Stokes analysis of secondary and tip-clearance flows in HP and LP gas turbine blade rows, and the influence of geometrical and aerothermal parameters on secondary and tip-clearance flows in turbine stages.

AIAA

Conferences; Secondary Flow; Axial Flow Turbines

19980058192

Overview of tip-clearance effects in axial turbines

Sjolander, S. A., Carleton Univ., Canada; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The current understanding of the gap flow in unshrouded axial turbines is reviewed. An overview of the tip leakage flow is presented, and its impact on the performance of axial turbines is summarized. The correlations that have been traditionally used to account for the effects of tip leakage in the preliminary design of axial turbines is reviewed. The physics of the gap flow is discussed in detail. A number of semi-empirical models that have been proposed for predicting various aspects of the gap flow are examined. These models are examined for their consistency with the present understandings of the physics of the flow. The application of 3D Navier-Stokes codes to the tip flow in turbines is summarized.

AIAA

Secondary Flow; Axial Flow Turbines

19980058193

Physics of tip-clearance flows. I

Sjolander, S. A., Carleton Univ., Canada; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The current understanding of tip-clearance flows as they apply to axial turbines is reviewed. The flow in the gap region is examined, with emphasis on flow into and inside the gap, surface pressures in the gap region, and gap flow at large clearances. The interaction of the tip-leakage flow with the endwall and main passage flows is discussed, with consideration given to the gap outlet flow, the interaction between the tip-leakage and passage vortices, and the turbulence field in the tip-leakge flow.

AIAA

Secondary Flow; Axial Flow Turbines; Pressure

19980058194

Physics of tip-clearance flows. II

Sjolander, S. A., Carleton Univ., Canada; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The physics of the tip-leakage flow as derived from low-speed cascade measurements is discussed. The effects of tip leakage on blade surface flow and blade loading are examined. Consideration is given to loss generation the tip-leakage flow, with emphasis on loss mechanisms and location of losses, variation of flow quantities with downstream distance, losses and large clearances, and tip-leakage, secondary, and end losses. Shed vorticity and ’retained lift’, compressibility, and the effect of relative wall motion on the tip-gap flow and on the downstream flow field and on blade loading are studied.

AIAA

Secondary Flow; Axial Flow Turbines; Compressible Flow

19980058195

Modelling of tip-clearance flows in axial turbines

Sjolander, S. A., Carleton Univ., Canada; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Modeling of tip-clearance flows in axial turbines that includes loss correlations is examined. An overview of various simple models for the mass flow rate through the gap and the size and strength of the leakage vortex is given. Modeling considerations for through-flow calculations are discussed. Full 3D Navier-Stokes analyses of the tip-leakage flow are presented. Recent tip-leakage computations for turbine cascades are provided in tabular form.

AIAA

Secondary Flow; Axial Flow Turbines; Three Dimensional Flow; Navier-Stokes Equation

19980058196

Physics of secondary flows

Gregory-Smith, D. G., Durham, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This lecture considers the physics of secondary flows in turbines. The basic cause of secondary flow is described as being due to the turning of the inlet boundary layer on the hub or casing. The details of flow in a linear cascade are described. The flow is complex, with highly 3D variations in flow angle and loss which are produced by three main vortices, called the passage vortex, the horseshoe vortex, and the suction surface corner vortex. Consideration is given to the turbulence structure, with high levels in the vortex regions and transitional or laminar flow on areas of the end wall and blade surfaces. The effects of annular geometry are described, with the effects of radial pressure gradients and centrifugal forces on loss migration being the most significant. In real machines, the effects of relative motion on the skewing of the inlet boundary layer can be considerable. The blade interaction effects are even more important, giving rise to time varying flow. This is an area where our understanding is not yet complete.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Cascade Flow; Turbulent Flow; Vortices

19980058197

Secondary flows and vorticity

Gregory-Smith, D. G., Durham, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A consideration of vorticity can aid the understanding of secondary flows in turbines. The methods whereby streamwise vorticity may be estimated at exit from a blade row are discussed, followed by the method whereby the secondary velocities may be obtained from the vorticity distribution. The effect of annular cascades compared to linear cascades is discussed. A more generalized approach to the vorticity transport equation which leads to ways in which more complicated flows may be calculated is described. Some results from computations are compared with experiment. The computations are much quicker than CFD-type calculations, and are suitable for early stages of turbine design in conjunction with throughflow methods.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Vorticity; Computational Fluid Dynamics; Inviscid Flow

19980058198

Secondary loss - Loss generation, effect of blade design, loss correlations and modelling

Gregory-Smith, D. G., Durham, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Secondary losses are very important in the performance of a turbine. The features of secondary loss and the mechanisms by which they are produced are discussed. The main sources are the action of shear forces on the surfaces, enhanced by the scraping action of the passage vortex and the new endwall boundary layer. Additional loss is caused by mixing out of the secondary velocities, but the extent of this is difficult to quantify. The blade loading and operating conditions affect secondary losses, and a brief review of loss correlations is given. The overall picture is rather variable, but more recent approaches trying to make more use of the understanding of flow physics have met with some success. Improvements in the prediction of secondary loss linked to systematic experimentation is an ongoing requirement.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Structural Design; Rotor Blades; Aerodynamic Loads

19980058199

CFD modelling of secondary flows

Gregory-Smith, D. G., Durham, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A brief description is given of some of the computational techniques that are currently used for turbomachinery computations. Detailed experimental data have been obtained from a low speed linear turbine cascade at Durham University. These data from the so called 'Durham Cascade' were used in one of the test cases for a series of seminar/workshops organized by the Special Interest Group in Turbomachinery of the European Research Community on Flow Turbulence and Combustion (ERCOFTAC). A large number of different computations of the secondary flow in this cascade were made. This lecture reviews the various results, together with some from the open literature. It is shown that there is a wide variation between the codes in the prediction of the strength and movement of the main passage vortex, and of the strength and position of the loss core. The predictions for a given code do not vary much qualitatively with grid refinement. There is little evidence that the more sophisticated turbulence models perform any better than the simpler models. The experimental data indicate that the flow is transitional, and so those codes that allow for some specification of the point of transition could show advantages.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Computational Fluid Dynamics; Turbulence Models; Reynolds Stress

19980058201

Secondary and tip clearance flows in axial turbines - Heat transfer aspects

Tan, C. S., MIT, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This lecture reviews work on the impact of secondary and tip clearance flows on heat transfer in axial turbines; in particular, the review focuses on those experimental and analytical/computational investigations that yield results that serve to establish causal links between the aerodynamics (i.e., those key flow features associated with the development of secondary and tip clearance flow) and the heat transfer distribution in axial turbine blade passages (i.e., on the endwall region and the blade surfaces). Key results are presented to elucidate the cause-and-effect relationships for both the stator and turbine rotor. The lectures address both the steady and unsteady aspects associated with the development of secondary and tip clearance flow and their potential impact on heat transfer processes.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Heat Transfer

19980058202

Full 3D turbine blade design

Haller, B. R., GEC Alsthom, UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

It has long been recognized that 'secondary' flow losses are significant in short height steam turbine stages. There has therefore been considerable scope for performance gains by effective control of these flows and considerable efforts have been made in this direction. Over the years, advances have been achieved by the complimentary application of: fundamental thinking to understand the physical processes which generate secondary loss and then to create innovative design concepts which reduce the loss and merit further detailed study; subsequent analysis and optimization of designs using advanced CFD methods; and experimental model turbine tests to prove the performance of new designs, prior to incorporation into production turbines. As well as the overall turbine performance, detailed measurements are obtained which allow the CFD methods to be developed and validated. The 3D blade design concepts which are covered include the influence of: profile shape, straight tangential lean, compound tangential lean, vortex design/controlled flow, wall shaping, fillet radii, and leakage flows.

Author (AIAA)

Secondary Flow; Axial Flow Turbines; Computational Fluid Dynamics; Three Dimensional Flow; Structural Design

19980058203

3D Navier-Stokes analysis of secondary and tip-clearance flows in HP and LP gas turbine blade rows

Duboue, J. M., SNECMA, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A 3D Navier-Stokes solver is used to analyze the secondary and tip-clearance flows in axial turbines. Two types of flows are discussed: those issued from several low-pressure nozzle guide vanes and those carried out with a high pressure unshrouded rotor. The experimental setup, raw tests results, and 3D Navier-Stokes code analysis are discussed for each type of configuration. The measurements and the CFD results carried out on four low-pressure nozzle guide vanes show that an aft bowed blade can be of utility for loss reduction. In an unshrouded rotor flow field, a tip-clearance vortex grows in the blade-tip gap due to the pressure gradient in the aft region of the blade. This vortex interacts with the two counterrotating passage vortices; thus, 50 percent of the flowpath can be affected.

AIAA

Secondary Flow; Axial Flow Turbines; Three Dimensional Flow; Gas Turbines; Turbine Blades

19980058204

Influence of geometrical and aerothermal parameters on secondary and tip-clearance flows in turbine stages

Duboue, J. M., SNECMA, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The CANARI 3D Navier-Stokes solver is used to study the influence of geometrical and aerothermal parameters on the secondary and tip-clearance flows in axial turbines. Depending on parameter changes, secondary flows in nozzle guide vanes are modified in intensity, location, and/or spread. When one of the tip-clearance heights increases, the tip-clearance vortex enlarges and modifies the upper leg of the secondary flows with which it interacts, resulting in high losses and flow angle radial gradient. Turbine efficiency is also greatly affected by these phenomena. It is argued that because so many parameters can vary in an engine turbine design, only a 3D Navier-Stokes solver offers the accuracy to model secondary and tip-clearance flows.

AIAA

Secondary Flow; Axial Flow Turbines; Aerothermodynamics

19980058298

Numerical analysis of two-dimensional compressible viscous flow in transonic compressor cascades

Zhao, Guiping, Northwestern Polytechnical Univ., China; Zhou, Xinhai, Northwestern Polytechnical Univ., China; Journal of Propulsion Technology; Dec. 1997; ISSN 1001-4055; Volume 18, no. 6, pp. 49-54; In Chinese; Copyright; Avail: Aeroplus Dispatch

A finite volume method is applied to solve the Navier-Stokes equations for 2D transonic flow in a compressor cascade. A fourth-order Runge-Kutta scheme is used improve the time-dependent solution. Turbulent properties are calculated using algebraic Baldwin-Lomax models. The effects of rotation, the variation of radius, and the thickness of the stream surface are taken into account. With high-pressure-ratio compressors, there is a strong tendency for the calculation to stall within the transient part of the flow. This can be solved by using a new technique of mass flow control. Comparisons of experimental and computational results with this method for four kinds of cascade in a wide inlet Mach number range are presented. The computed results are satisfactory, especially for supersonic inflow.

Author (AIAA)

Two Dimensional Flow; Compressible Flow; Viscous Flow; Cascade Flow; Compressor Blades; Transonic Compressors; Computational Fluid Dynamics; Navier-Stokes Equation

19980058389

An introduction to evolutionary algorithms and their application to the aerofoil design problem. II - The results

De Falco, I., NRC, Inst. for Research on Parallel Information Systems, Italy; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper is the second part of a short course on the use of evolutionary algorithms (EAs) as an effective means to solve the airfoil design problem in aerodynamics. Their application to both the direct and the inverse airfoil design problem is described, and results are given. Finally, several possible parallel models for EAs are discussed, and the results of the application of one of them to the above problem are presented.

Author (AIAA)

Airfoil Profiles; Structural Design; Inviscid Flow; Subsonic Flow

19980058390

A Euler/Navier-Stokes inverse method for compressor and turbine blade design

Demeulenaere, A., von Karman Inst. for Fluid Dynamics, Belgium; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A viscous/inviscid inverse method for the design of compressor and turbine blades is presented. It iteratively modifies an initial geometry until a prescribed pressure distribution is reached on the blade surfaces. The method solves the time-dependent Euler/Navier-Stokes equations in a numerical domain of which some boundaries (the blade walls) move and change shape during the transient part of the computation. Each iteration of the procedure starts with the blade shape modification, based on the transpiration model and the permeable wall concept. A new mesh is then generated, and the flow field is updated by performing one finite volume time iteration, taking into account the mesh points movement during the time stepping. The time marching computation and blade modifications converge simultaneously to the required geometry and steady-state flow field. The method is based on a high resolution finite volume solver, with an upwind-biased evaluation of the advective fluxes for sharp shock wave capturing and low numerical entropy generation.

Author (AIAA)

Euler Equations of Motion; Navier-Stokes Equation; Compressor Blades; Turbine Blades; Structural Design

19980058391

Aerodynamic optimization with evolutionary algorithms

Obayashi, Shigeru, Tohoku Univ., Japan; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Applicability of evolutionary algorithms to aerodynamic optimization is discussed within the framework of airfoil/wing design problems. The distribution of the objective function is shown for a simplified problem. to find a global optimum from this rough distribution of the aerodynamic objective function, robustness of genetic algorithms (GAs) is desired. A brief description of a GA and its extension to multiobjective optimization problems are given. A multiple-objective GA (MOGA) is applied to multidisciplinary optimization of transonic wing planform design. The results indicate the feasibility of MOGAs as a system-level optimizer.

Author (AIAA)

Airfoil Profiles; Wing Profiles; Structural Design; Genetic Algorithms; Multidisciplinary Design Optimization

19980058392

Target pressure optimization using MOGA

Obayashi, Shigeru, Tohoku Univ., Japan; 1997; In English; Copyright; Avail: Aeroplus Dispatch

To alleviate the large computational time necessary for coupling CFD with genetic algorithms (GAs), the inverse optimization method has been developed to optimize target pressure distributions. Once the target pressure is given, the corresponding geometry can be found by an inverse code coupled with a Navier-Stokes solver. In 2D, viscous drag is minimized under specified lift and airfoil thickness. In 3D, a multiple-objective GA (MOGA) based on the Pareto ranking method is employed. The present design procedure allows the minimization of the induced drag, while maintaining the straight isobar pattern of pressures. The resulting procedure is shown to be successful when applied to transonic wing design.

Author (AIAA)

Optimization; Computational Fluid Dynamics; Genetic Algorithms; Transonic Flow; Wing Profiles; Navier-Stokes Equation

19980058394

Turbomachinery blade design using a Navier-Stokes solver and artificial neural network

Pierret, S., von Karman Inst. for Fluid Dynamics, Belgium; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Consideration is given to an original method for the design of turbine blades that employs a data base and an artificial neural network in order to gain expertise from the preceding Navier-Stokes results in a way that can be used for the optimization of the blade shape. It is shown that only a few modifications are needed to design a blade that satisfies aerodynamic as well as mechanical requirements.

AIAA

Turbine Blades; Structural Design; Navier-Stokes Equation; Neural Nets

19980058395

Aerodynamic design optimisation for complex geometries using unstructured grids

Giles, M. B., Oxford, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The use of unstructured grid CFD methods in the design of complex aeronautical geometries is discussed. The emphasis is on gradient-based optimization approaches. The evaluation of approximate and exact linear sensitivities is described, as are different ways of formulating the adjoint equations to greatly reduce the computational cost when dealing with large numbers of design parameters. The current state of the art is illustrated by two examples from turbomachinery and aircraft design.

Author (AIAA)

Aerodynamic Configurations; Computational Grids; Optimization; Computational Fluid Dynamics

19980058411

Design and development of a dynamically deforming leading edge airfoil for unsteady flow control

Chandrasekhara, M. S., NASA, USA; Carr, L. W., NASA Ames Research Center, USA; Wilder, M. C., MCAT, Inc., USA; Paulson, G. N., NASA Ames Research Center, USA; Sticht, C. D., NASA Ames Research Center, USA; 1997, pp. 132-140; In English; Copyright; Avail: Aeroplus Dispatch

A novel approach to unsteady flow separation and dynamic stall control using a dynamically deforming leading edge airfoil is described. The design details of a carbon-fiber composite skin airfoil having a thickness of 0.002 inch at the leading edge and capable of deforming at 20 Hz in unsteady flow at freestream Mach numbers of up to 0.45 are discussed. Implementation of the scheme at model scales places extraordinary demands on the design, material, and fabrication of such an airfoil. Rate scaling further requires very-rapid-response instrumentation, measurement techniques, and data acquisition schemes. The special instrumentation control system developed for these experiments as well as the fluid dynamic results of successful flow control that was achieved using this method are also discussed.

Author (AIAA)

Unsteady Flow; Leading Edges; Separated Flow; Aeroelasticity; Airfoil Oscillations

19980058412

A system for analysis of transition characteristics on a high-lift configuration at high Reynolds numbers

Bertelrud, Arild, Analytical Services and Materials, Inc., USA; Johnson, Sherylene, NYMA, Inc., USA; Lytle, Carroll, NYMA, Inc., USA; Mills, Carl, NYMA, Inc., USA; 1997, pp. 141-152; In English

Contract(s)/Grant(s): NAS1-19864; Copyright; Avail: Aeroplus Dispatch

The characteristic features of a system developed for transition documentation in a high-lift flow-physics code validation experiment in the Low Turbulence Pressure Tunnel (LTPT) at NASA Langley Research Center are described. A three-element

high-lift model of McDonnell-Douglas (MDA) design was used for the experiment, with Reynolds number ranging from 5 to 12 million based on the chord length. Roughly 100 different flow conditions were documented through variation of rigging, angle of attack, Mach number, and Reynolds number. More than 350 surface hot films were used to characterize transition regions.
Author (AIAA)
High Reynolds Number; Transition Flow; Lift Augmentation; Aircraft Configurations

19980058414
The investigation of the power characteristics of two-dimensional asymmetric nozzles
Zudov, Vladimir N., Russian Academy of Sciences, Inst. of Theoretical and Applied Mechanics, Russia; Lokotko, Anatoliy V., Russian Academy of Sciences, Inst. of Theoretical and Applied Mechanics, Russia; 1997, pp. 163-173; In English; Copyright; Avail: Aeroplus Dispatch

A series of studies of the construction of optimal supersonic 2D asymmetric nozzles and their off-design regimes was carried out. The variation problem of the design of the supersonic 2D asymmetric nozzles with maximum thrust at given lift power and given size limitations was solved. The method of characteristics was used. Structures of flow and power characteristics in nozzles are numerically investigated at transonic and supersonic speeds of external flow. It was experimentally and numerically studied power characteristics and 3D phenomena of 2D asymmetric nozzle .
Author (AIAA)
Nozzle Design; Two Dimensional Bodies; Supersonic Nozzles; Thrust; Asymmetry

19980058835 Lockheed Engineering and Sciences Co., Hampton, VA USA
Reynolds-Averaged Navier-Stokes Simulations of Two Partial-Span Flap Wing Experiments
Takalluk, M. A., Lockheed Engineering and Sciences Co., USA; Laflin, Kelly R., National Academy of Sciences - National Research Council, USA; 1998; 16p; In English; 36th; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS1-96014
Report No.(s): NASA/CR-1998-207314; NAS 1.26:207314; AIAA Paper 98-0701; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Structured Reynolds Averaged Navier-Stokes simulations of two partial-span flap wing experiments were performed. The high-lift aerodynamic and aeroacoustic wind-tunnel experiments were conducted at both the NASA Ames 7-by 10-Foot Wind Tunnel and at the NASA Langley Quiet Flow Facility. The purpose of these tests was to accurately document the acoustic and aerodynamic characteristics associated with the principle airframe noise sources, including flap side-edge noise. Specific measurements were taken that can be used to validate analytic and computational models of the noise sources and associated aerodynamic for configurations and conditions approximating flight for transport aircraft. The numerical results are used to both calibrate a widely used CFD code, CFL3D, and to obtain details of flap side-edge flow features not discernible from experimental observations. Both experimental set-ups were numerically modeled by using multiple block structured grids. Various turbulence models, grid block-interface interaction methods and grid topologies were implemented. Numerical results of both simulations are in excellent agreement with experimental measurements and flow visualization observations. The flow field in the flap-edge region was adequately resolved to discern some crucial information about the flow physics and to substantiate the merger of the two vortical structures. As a result of these investigations, airframe noise modelers have proposed various simplified models which use the results obtained from the steady-state computations as input.
Author
Navier-Stokes Equation; Computerized Simulation; Aeroacoustics; Aerodynamic Noise; Aircraft Noise; Flow Visualization; Reynolds Averaging; Transport Aircraft; Computational Fluid Dynamics

19980060295
Analysis of axisymmetric caverns in the wake of a disk in supersonic flow ***Raschet osesimmetrichnykh kavern za diskom v sverkhzvukovom potoke***
Vasin, A. D., Russia; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 54-62; In Russian; Copyright; Avail: Aeroplus Dispatch

Cavitation flow past a disk in supersonic flow is calculated for freestream Mach 1-1.2 using the finite difference method. The principal geometrical parameters of the cavitation flow, drag coefficient, and the distance from the shock wave to the disk surface are determined.
AIAA
Axisymmetric Flow; Disks (Shapes); Supersonic Flow; Cavity Flow; Finite Difference Theory; Drag Coefficients

19980060300

Optimization of the powerplant of a hypersonic flight vehicle with a ramjet engine ***Optimizatsiya silovoj ustanovki giperzvukovogo letatel'nogo apparata s pryamotochnym vozdushno-reaktivnym dvigatelem***

Baftalovskij, S. V., Russia; Krajko, A. N.; Makarov, V. E.; Tillyaeva, N. I.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 126-135; In Russian; Copyright; Avail: Aeroplus Dispatch

The optimization of the ramjet engine of a hypersonic flight vehicle is discussed for the case of supersonic velocity in the combustion chamber. The combustion chamber is calculated in the one-dimensional approximation, while flow in the air intake and in the nozzle as well as flow around the vehicle are calculated in the two-dimensional approximation. The optimal lengths of the air intake and of the lower and upper walls of the nonsymmetric nozzle are determined in accordance with the selected optimality criterion.

AIAA

Aircraft Engines; Hypersonic Vehicles; Hypersonic Flight; Ramjet Engines; Supersonic Flow; Combustion Chambers

19980060302

Development of the wave potential theory in nonstationary problems of separated supersonic gas flow around three-dimensional lifting systems ***Razvitie teorii volnovogo potentsiala v nestatsionarnykh zadachakh otryvnogo obtekaniya prostranstvennykh nesushchikh sistem sverkhzvukovym potokom gaza***

Gras'kin, S. S., Russia; Nisht, M. I.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 136-152; In Russian; Copyright; Avail: Aeroplus Dispatch

The wave potential theory is developed for solving problems of nonstationary supersonic separated flow of an isentropic gas past arbitrary lifting systems. The formultation of the problem and the derivation of the main integral formula of the Kirchhoff type are presented. The corresponding boundary value problems are formulated and reduced to singular integral equations. Numerical implementations and examples of calculations are included.

AIAA

Supersonic Flow; Unsteady Aerodynamics; Potential Theory; Separated Flow; Lifting Bodies; Wave Propagation

19980060303

Numerical modeling of hypersonic flow of a rarefied gas past thin bodies ***Chislennoe modelirovanie giperzvukovogo obtekaniya tonkikh tel potokom razrezhennogo gaza***

Erofeev, A. I., Russia; Provotorov, V. P.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 153-164; In Russian; Copyright; Avail: Aeroplus Dispatch

Multiparameter calculations of hypersonic flow of a rarefied gas past slender cones and wedges are carried out by using the direct simulation Monte Carlo method. The results obtained are then used to determine the applicability limits of the similarity criteria in the transition region for hypersonic flow of a viscous gas past thin bodies. Some generalized parameters which allow the correlation of the full drag coefficient and of the local aerodynamic characteristics are examined.

AIAA

Hypersonic Flow; Rarefied Gas Dynamics; Thin Bodies; Drag Coefficients; Transition Flow; Aerodynamic Characteristics

19980060305

Formation of simple CO2 clusters in hypersonic nozzles and their effect on the gasdynamic and aerodynamic parameters ***Obrazovanie prostejshikh klasterov CO2 v soplakh giperzvukovykh ustanovok i ikh vliyanie na gazodinamicheskie i aehrodinamicheskie parametry***

Egorov, B. V., Russia; Markachev, Yu. E.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 165-170; In Russian; Copyright; Avail: Aeroplus Dispatch

The formation of carbon dioxide dimers, (CO2)2, in the supersonic region of hypersonic wind tunnels is simulated numerically. Particular attention is given to the effect of nonequilibrium formation and decay of clusters in the test section of wind tunnels and behind shock waves on the gasdynamic parameters. The results provide a way to esimate changes in the force and moment aerodynamic characteristics of flight vehicle models at the initial stage of cluster formation.

AIAA

Hypersonic Nozzles; Carbon Dioxide; Gas Dynamics; Aerodynamic Characteristics; Hypersonic Wind Tunnels; Flight Vehicles

19980061819

Variability of rotor wake interactions and airfoil unsteady aerodynamics

Sanders, Albert J., Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; 1997, pp. 411-418; In English; Copyright; Avail:

Aeroplus Dispatch

Multistage interaction effects on rotor blade-to-blade wake variability and the resulting downstream vane row unsteady aerodynamic response are experimentally investigated in a high-speed fan stage. Multistaging effects on the rotor wake are quantified by acquiring data over two complete rotor revolutions at each of several IGV clocking positions relative to downstream stationary probes. The resulting downstream vane response data are acquired over a range of steady loading conditions, with both design and off-design operation of the rotor considered. Multistage interactions are shown to significantly affect the rotor wake characteristics and lead to the generation of rogue wakes. The fundamental periodicity of these interactions is one complete rotor revolution due to the unequal number of blades and vanes in the machine. The rotor wake and resultant vane row unsteady aerodynamic response variability are also quantified. Off-design rotor operation results in wakes with the largest variability, on the order of the average velocity deficit. The vane response variability is even more pronounced, being as large as 160 percent of the maximum average unsteady lift over one blade pass period.

Author (AIAA)

Rotor Blades; Unsteady Aerodynamics; Airfoil Oscillations; Aircraft Wakes; Fatigue Life; Rotor Body Interactions

19980061822

Aerodynamic response of turbomachinery blade rows to convecting density wakes

Ramer, Becky E., MIT, USA; Wijesinghe, Sanith, MIT, USA; Tan, Choon, MIT, USA; Covert, Eugene E., MIT, USA; 1997, pp. 433-441; In English

Contract(s)/Grant(s): F49620-94-1-0202; Copyright; Avail: Aeroplus Dispatch

Convecting density wakes have not been considered as a source of unsteady aerodynamic loading on turbomachinery blade rows. These unsteady loads can influence high cycle fatigue failure of blades and vanes in gas turbine engines. This study elucidates the temporal evolution of density wakes and determines key controlling parametric trends on blade loading. Inviscid numerical calculations are conducted to illustrate the basic flow field in the absence of boundary layer interactions. The profile and scaling of the unsteady loads are given for two density gradient distributions.

Author (AIAA)

Rotor Blades; Unsteady Aerodynamics; Aircraft Wakes; Aerodynamic Loads; Density Distribution

19980061828

Flow past a blunt flat plate subjected to the disturbance of incident vortex street

Chen, Jerry M., Natl. Chung Hsing Univ., Taiwan, Province of China; Chiou, Chain-Cheng; Journal of Wind Engineering and Industrial Aerodynamics; Mar, 1997; ISSN 0167-6105; Volume 66, no. 3, pp. 179-196; In English; Copyright; Avail: Issuing Activity

An experimental investigation was conducted to study the flow past a square leading-edge flat plate subjected to the disturbance of a Karman vortex street. The experiments were carried out in a wind tunnel using flow visualization together with surface pressure measurements, at a Reynolds number of 1000 based on the plate thickness. The incident vortex street was generated by employing a symmetrical airfoil located at a certain distance upstream of the test plate. The vertical offset between the incident vortex street and the plate was varied in the range 0-5 of plate thicknesses. It was found that at small vertical offsets, the incident vortices were distorted or split by the presence of the plate and secondary vortex shedding from the leading edge was induced, resulting in a sharp rise in mean pressure distribution immediately downstream of the leading edge. At large vertical offsets, the incident vortices preserved their coherence when passing over the plate and the separated shear layer was observed reattaching to the plate surface at a more downstream position as the vertical offset was increased. The pressure measurements also reflected the variation of the reattachment length with the vertical offset.

Author (EI)

Flat Plates; Karman Vortex Street; Leading Edges; Vortex Shedding; Vortex Streets; Aerodynamics; Wind (Meteorology); Wind Tunnels; Flow Visualization; Metal Plates

19980062987

Effects of air coolant injection on cascade surface pressure distribution

Chen, Fu, Harbin Inst. of Technology, China; Yang, Hong, Harbin Inst. of Technology, China; Gong, Gunzhong, Harbin Inst. of Technology, China; Feng, Guotai, Harbin Inst. of Technology, China; Wang, Zhongqi, Harbin Inst. of Technology, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 57-60; In Chinese; Copyright; Avail: Aeroplus Dispatch

The effects on turbine blade surface pressure distribution were investigated experimentally with air coolant discharge from each of nine individual rows of coolant holes, on the blade surface in a rectilinear cascade with typical turbine guide van profile. Mass flow ratios of air coolant to mainstream were 0, 0.6, and 1.2 percent, respectively. The experimental results showed that the

variations of the surface pressure distribution were dependent chiefly on the amount of air coolant and the location of injecting holes. Injection from the blade leading edge against the mainstream altered the surface pressure distribution slightly, and the pressure surface injection did not change the surface pressure distribution as the suction surface injection due to the difference of mainstream pressure gradients and mainstream velocity. The surface pressure decrease caused by a kidney-shaped vortex was more significant than the pressure increase due to the mainstream stagnation due to air coolant injection.
Author (AIAA)
Turbine Blades; Guide Vanes; Air Cooling; Pressure; Pressure Distribution; Gas Injection

19980062991

Investigation of single film cooling with compound-angle orientation

Xu, Hongzhou, Xian Jiaotong Univ., China; Wang, Sanglin, Xian Jiaotong Univ., China; Liu, Songling, Northwestern Polytechnical Univ., China; Xheng, Fuqun, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 69-71; In Chinese; Copyright; Avail: Aeroplus Dispatch

The effects of blowing ratio at M = 1.0 and 2.0 on the downstream flow field of a single film cooling hole with compound-angle orientations have been investigated experimentally. It is found that a pair of counterrotating vortices, one of which is strong and the other weak, were observed in the downstream region of the jet exit. The hole with a fan-shaped angle of 0 or 15 deg was oriented so that its angles with respect to the test surface are 60 deg in a stream/normal plane projection, and 30 or 45 deg in a spanwise/normal plane projection. Contours of longitudinal velocity show asymmetric kidney shape. The fan-shaped hole effectively decreases the strength of longitudinal vortex and increases the spreading of the jet, and so would be much greater than that found in the downstream of a circular hole.
Author (AIAA)
Fan Blades; Jet Flow; Hole Geometry (Mechanics); Film Cooling; Vortices

19980062997

An experimental study on primary nozzle types of exhaust ejector systems

Li, Li, Beijing Univ. of Aeronautics and Astronautics, China; Xu, Zhiyong, Beijing Univ. of Aeronautics and Astronautics, China; Wu, Shousheng, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 85-88; In Chinese; Copyright; Avail: Aeroplus Dispatch

Optimum distances between primary nozzle exit and mixing tube inlet, static pressure recovery of the mixing flow in mixing tube, total pressure distributions at the exit of mixing tube, pumping coefficients, and total pressure losses of an exhaust ejector systems with four different types of primary nozzles have been measured. The results have an important reference value for selecting the primary nozzle types of exhaust ejector systems.
Author (AIAA)
Exhaust Systems; Ejectors; Nozzle Design; Aerodynamic Characteristics; Static Pressure

19980063003

3-D numerical simulation of blade-angle slotted hub treatment

Li, Ling, Beijing Univ. of Aeronautics and Astronautics, China; Lu, Yajun, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 99-102; In Chinese; Copyright; Avail: Aeroplus Dispatch

The 3D incompressible steady time-averaged Navier-Stokes equation, continuity equation, and k-epsilon turbulence model equations are applied to calculation of the flowfield in the cascade passage with blade-angle slotted hub treatment. The mechanism of extending stability by blade-angle slotted hub treatment is elaborated by means of a 3D viscous numerical simulation. It is revealed that a pressure difference between suction and pressure sides induces a strong flow which enters in the rear of the slot and exits from the front of the slot. This flow blows off the low energy boundary layer and retards stall emergence. The SIMPLE algorithm with nonstaggered grid is employed to solve the problem of the pressure oscillation.
Author (AIAA)
Compressor Blades; Unsteady Aerodynamics; Three Dimensional Models; Hubs; Cascade Flow; Slotted Wind Tunnels

19980063032

A survey on application of curved blades to compressor cascade

Zhong, Jingjun, Harbin Inst. of Technology, China; Su, Jiexian, Harbin Inst. of Technology, China; Wang, Zhongqi, Harbin Inst. of Technology, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 7-12; In Chinese; Copyright; Avail: Aeroplus Dispatch

Based on the mechanism of controlling secondary flow with the help of curved blades in turbomachinery, the specific factors involved in the application of the curved blades to a compressor cascade are considered. An international literature survey of the current development status of the research, practical applications, and prospects for use of curved blades in compressor cascades is made, giving attention to the results of experimental investigations.
Author (AIAA)
Compressor Blades; Cascade Flow; Secondary Flow; Aerodynamic Characteristics

19980063034

Numerical simulation of 3D transonic viscous flow structure inside a compressor rotor with consideration of tip clearance

Guo, Yanhu, Tsinghua Univ., China; Wang, Baoguo, Tsinghua Univ., China; Shen, Mengyu, Tsinghua Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 13-18; In Chinese; Copyright; Avail: Aeroplus Dispatch

A 3D numerical solution of transonic turbulent flowfield inside a compressor rotor is analyzed with consideration of blade tip clearance. The complex vortex system structure and shock wave system structure inside this rotor are obtained. Wall flow patterns on the blade surface and hub surface are found. The complex vortex system structures (horseshoe vortex, passage vortex, corner vortex and trailing vortex), and their interactions with shock wave systems are researched. The character of the tip clearance flow inside the rotor passage is revealed, and the interaction between shock wave and tip clearance flow near the blade tip, and the evolution of tip clearance flow, are all considered.
Author (AIAA)
Transonic Compressors; Compressor Rotors; Transonic Flow; Flow Characteristics; Viscous Flow

19980063036

Application of a multi-dimensional flux function to analysis of plane transonic cascade flow

Yao, Shilei, Tsinghua Univ., China; Wang, Baoguo, Tsinghua Univ., China; Shen, Mengyu, Tsinghua Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 19-22; In Chinese; Copyright; Avail: Aeroplus Dispatch

In 2D or 3D flow fields, it is difficult to determine the direction of wave propagation in cascades due to the complexity of transonic flow. Now, a grid-independent approximate Riemann solver is applied to numerical simulation of 2D transonic cascade flow by means of the Euler or Navier-Stokes equations. Fluxes on grid faces are obtained via wave decomposition, assuming that information propagates in the velocity-difference directions, rather than in the grid-normal directions as in a standard grid-aligned solver. Second-order computations with the grid-independent flux function are used to analyze two typical examples of transonic cascades. The results indicate that the grid-independent model suppresses entropy production over the cascade surface due to either computational diffusion or grid viscosity, and resolves shock and shear waves in transonic flow of cascades much better than alternatives.
Author (AIAA)
Transonic Flow; Cascade Flow; Computational Grids; Two Dimensional Flow; Wave Propagation

19980063038

Experimental investigation of fish scale patterned cascade

Miao, Runtian, Liming Engine Manufacturing Co., China; Wang, Liangui, Liming Engine Manufacturing Co., China; Gao, Ge, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 27-29; In Chinese; Copyright; Avail: Aeroplus Dispatch

Several cascades with different patterns have been tested with the purpose of turbulence drag reduction in compressors, after a straight-patterned cascade obtained notable effects. The fish-scale patterned cascade is the best of these. The main performance comparison shows that most performance indices of the fish-scale patterned cascade, such as critical Mach number, maximum 2D static compression ratio, and total pressure loss coefficient at maximum attack angle, are all improved over the straight-patterned cascade. The other performance parameters, namely attack angle range, flow deflection angle at design point, and corresponding deviation angle at design point, are superior to the reference cascade as well. It is worth noting that the fish-scale pattern and the straight pattern can be used together in the same blade, to obtain advantageous performance.
Author (AIAA)
Compressor Efficiency; Cascade Flow; Drag Reduction; Compressor Blades; Flow Geometry; Compression Ratio

19980064086

Influence of crossflow and turbulence on vortex flow around a supersonic missile

Grasso, F., Roma I, Univ., Italy; Iaccarino, G., Centro Italiano Ricerche Aerospaziali, Italy; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 37-45; In English; Copyright; Avail: Aeroplus Dispatch

A 3D Reynolds averaged Navier-Stokes solver is applied to analyze the aerodynamic behavior of supersonic missile configurations in the presence of crossflow. The model employs a low Reynolds k-epsilon model, and relies on a finite volume multiblock strategy that exploits local grid refinement. A large set of experimental data is used to validate the simulations and to verify the grid sensitivity of the solutions. An analysis of the skin-friction pattern and of the crossflow vortex structures at different angles of attack shows that the influence of turbulence is strong only for low incidence. At higher angles of attack, the flow is dominated by streamwise vorticity production.
Author (AIAA)
Cross Flow; Vortices; Supersonic Flight; Missiles; K-Epsilon Turbulence Model; Three Dimensional Flow

19980064095
Flowfield over bulbous heat shield in transonic and low supersonic speeds
Mehta, R. C., ISRO, Vikram Sarabhai Space Centre, India; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 102-105; In English; Copyright; Avail: Aeroplus Dispatch

A three-stage Runge-Kutta time-stepping scheme is the basis of a numerical experiment concerning the axisymmetric turbulent viscous flow over a bulbous heat shield. The location of the terminal shock is found as a nonlinear function of the freestream Mach number. It is established that the terminal shock moves downstream with increasing freestream Mach number, and that the flowfield features of the separated region are different in the transonic and supersonic Mach number ranges.
AIAA
Heat Shielding; Transonic Speed; Flow Distribution; Supersonic Speed; Computational Fluid Dynamics; Runge-Kutta Method; Baldwin-Lomax Turbulence Model; Turbulent Flow

19980064096
Euler solution of axisymmetric jets in supersonic external flow
Yilmaz, Erdal, Middle East Technical Univ., Turkey; Kavsaoglu, Mehmet S., Middle East Technical Univ., Turkey; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 105-107; In English; Copyright; Avail: Aeroplus Dispatch

In the present study of exhaust plume expansion into a supersonic external freestream, the axisymmetric Euler equations were solved via a finite-volume technique on unstructured triangular grids. Plume boundary and other flowfield details were obtained. It is found that the accuracy of jet plume boundary predictions strongly depends on the initial and adapted meshes.
AIAA
Axisymmetric Flow; Supersonic Flow; Computational Fluid Dynamics; Euler Equations of Motion; Finite Volume Method; Supersonic Jet Flow; Exhaust Flow Simulation

19980064098
Technique to reduce yaw and jump in fin-stabilized projectiles
Schmidt, Edward M., U.S. Army, Research Lab., USA; Donovan, William F., U.S. Army, Research Lab., USA; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 110, 111; In English
Report No.(s): AIAA Paper 97-0424; Copyright; Avail: Aeroplus Dispatch

An account is given of the use of a novel, gimballed-nose technique for reducing the nose-lift of fin-stabilized kinetic-kill artillery projectiles, which has been devised in the hope of reducing initial maximum yaw and aerodynamic jump. A worthwhile improvement in the aerodynamics of such projectiles has been experimentally established.
AIAA
Yaw; Finned Bodies; Projectiles

19980064146
Heat flux on partially catalytic surfaces in hypersonic flows
Serpico, M., Centro Italiano Ricerche Aerospaziali, Italy; Monti, R., Napoli II, Univ., Italy; Savino, R., Napoli II, Univ., Italy; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 9-15; In English; Copyright; Avail: Aeroplus Dispatch

The combined effects of the chemical nonequilibrium and the surface catalysis on the stagnation-point heat flux of a blunt body are investigated by Navier-Stokes calculations on a spherical model under Scirocco Plasma Wind Tunnel conditions. The freestream properties in the test section are found by means of a preliminary nonequilibrium, full Navier-Stokes computation of the nozzle flow expansion. All available numerical heat flux results are correlated as a function of a dimensionless parameter, including the simultaneous effects of the finite-gas and the surface-phase reactions. The proposed parameter, which takes into

account simultaneously the nonequilibrium effects in the bulk and surface phases, correlates well with the numerical results over a blunt-body stagnation region. The final correlation formula for the stagnation heat flux can be used to correlate experimental results on different materials with known catalytic coefficients or, conversely, to determine the surface catalytic efficiency of different thermal protection materials.
Author (AIAA)
Heat Flux; Catalysis; Hypersonic Flow; Stagnation Point; Blunt Bodies; Navier-Stokes Equation

19980064147

High-altitude capsule aerodynamics with real gas effects

Ivanov, M. S., Russian Academy of Sciences, Inst. of Theoretical and Applied Mechanics, Russia; Markelov, G. N., Russian Academy of Sciences, Inst. of Theoretical and Applied Mechanics, Russia; Gimelshein, S. F., Russian Academy of Sciences, Inst. of Theoretical and Applied Mechanics, Russia; Mishina, L. V., RSC 'Energiya', Russia; Krylov, A. N., RSC 'Energiya', Russia; Grechko, N. V., RSC 'Energiya', Russia; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 16-22; In English
Report No.(s): AIAA Paper 97-0476; Copyright; Avail: Aeroplus Dispatch

Reentry capsule aerodynamics within a wide range of angles of attack and flight altitudes are examined by the direct simulation Monte Carlo method. The local bridging method is verified by comparison with results of simulations. Capsule stability is analyzed for flight altitudes from 130 km down to 85 km. Comparison between computed and free flight data shows a good agreement. A qualitative change of heat transfer coefficient behavior for different angles of attack during the descent is revealed. The influence of chemical reactions on aerodynamics and flowfields at 85 km is shown to be significant. For a flow simulation in the near-continuum regime, a parallel version of the direct simulation code, with static and dynamic load balancing techniques, is used. An efficiency of about 80 percent is obtained for 256 processors using dynamic load balancing.
Author (AIAA)
High Altitude; Space Capsules; Real Gases; Reentry; Angle of Attack

19980064148

Pressure measurements on a Mach 5 sabot during discard

Dick, Jason N., Texas, Univ., Austin, USA; Dolling, David S., Texas, Univ., Austin; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 23-29; In English
Report No.(s): AIAA Paper 96-2042; Copyright; Avail: Aeroplus Dispatch

An experimental program has been conducted in a Mach 5 airflow to obtain surface pressures in the scoop and on the underside of a sabot at different stages of the discard process. The data are needed to validate computer codes used for predicting the trajectory of the sabot during discard and to aid in the design of minimum-interference sabots. Because of wind-tunnel size constraints, the tests were carried out using a model with one sabot petal. The remaining sabot petals were modeled by using splitter plates as symmetry planes. Assessment of the data indicates that the complex flow structure between the sabot and projectile is simulated using this approach. Because of the complex shock-shock and shock-boundary-layer interactions, the pressure distributions on the sabot underside have very distinctive shapes with large maxima; if a code can locate these maxima and predict their magnitudes reasonably well, then the integrated forces and moments (which determine the sabot trajectory) should be modeled reasonably accurately. The current data should prove useful in that regard.
Author (AIAA)
Pressure Measurement; Air Flow; Sabot Projectiles

19980064149

Forebody precompression effects and inlet entry conditions for hypersonic vehicles

Berens, Thomas M., Daimler-Benz AG, Germany; Bissinger, Norbert C., Daimler-Benz AG, Germany; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 30-36; In English
Report No.(s): AIAA Paper 96-4531; Copyright; Avail: Aeroplus Dispatch

To efficiently provide precompressed air to the engine inlets, a hypersonic forebody requires a design with potentially contradictory optimization goals: a high static pressure for the inlet entry flow and a large air mass flow to reduce engine size and hence vehicle drag, the maximization of the total kinetic energy for the inlet air, and a small Mach number and flow distortion across the inlet face to guarantee the undisturbed operation of inlets and engines. Starting with basic elliptic, flat, and concave cross sections of the forebody's bottom side, 11 sharp-nosed, hypersonic flight-test-vehicle type forebodies of varying cross-sectional shapes were designed for a numerical investigation of their influence on propulsion and aerodynamic performance. The 3D Euler calculations were carried out for flight Mach numbers 3.5 and 6.8 at angles of attack of 0 and 6 deg. Slim narrow forebodies provide

the highest air mass flow rates for the engines and result in the lowest total pressure losses for the inlet entry area. Their external aerodynamic behavior is characterized by low drag and large lift components. Elliptical and concave cross-sectional shapes of the forebody's bottom side are preferable to flat geometries.
Author (AIAA)
Forebodies; Hypersonic Vehicles; Compressed Air; Engine Inlets; Air Flow; Aircraft Design

19980064831

Numerical simulations of the three-dimensional turbulent flow in a wind park

Masson, Christian, Ecole de Technologie Superieure, Canada; Ammara, Idriss, Ecole Polytechnique, Canada; Leclerc, Christophe, Ecole Polytechnique, Canada; Paraschivoiu, Ion, Ecole Polytechnique, Canada; 1998, pp. 282-293; In English
Report No.(s): AIAA Paper 98-0058; Copyright; Avail: Aeroplus Dispatch

CFD is a promising tool for the analysis and optimization of the wind turbines positioned inside a wind park. In the present work, the 3D, time-averaged, steady-state, incompressible Navier-Stokes equations are solved along with the k-epsilon turbulence model. Wind turbines are represented by momentum sources, and a Control-Volume FEM (CVFEM) is used to solve the flow equations for the velocity components, pressure, and turbulence characteristics. The authors' previous works demonstrated the accuracy of this approach for single wind turbine power prediction. The capabilities of the proposed method to predict wind turbine wake characteristics are illustrated in this paper. Results for the MOD-0A wind turbine in neutral atmospheric boundary layers are presented, and a simple park composed of two turbines, one behind the other, is studied. Satisfactory agreement with experimental measurements is achieved, and qualitative agreement with observations is obtained for gross wake characteristics.
Author (AIAA)
Wind Turbines; Turbulent Flow; K-Epsilon Turbulence Model; Three Dimensional Flow; Finite Element Method; Rotor Blades

19980064839

Recent progress in drag prediction and reduction for civil transport aircraft at ONERA

Schmitt, V., ONERA, France; Destarac, D., ONERA, France; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0137; Copyright; Avail: Aeroplus Dispatch

The paper gives a survey of recent work at ONERA in the fields of drag prediction and drag reduction. The far-field drag analysis has been extended to Euler codes. This approach enables physical drag sources to be identified and artificial (spurious) drag to be eliminated. Progress achieved in drag prediction of inviscid flow is illustrated through appropriate examples of drag analysis on an airfoil, a wing and a wing-body configuration. A first application of the far-field analysis to Navier-Stokes codes is also reported. First results obtained for an airfoil are promising. As far as drag reduction is concerned, the main efforts are devoted to the evaluation of advanced concepts tackling the main drag sources of a civil transport aircraft which are wave drag, lift induced drag, and skin friction drag. The first case presented deals with wave drag reduction of an airfoil through local wall deformation. Significant improvements predicted after design modification have been confirmed by an experimental verification. Then, the potential to reduce lift induced drag by a careful design of a particular wing tip device is discussed. Finally, progress in hybrid laminar flow investigations is demonstrated.
Author (AIAA)
Drag Reduction; Civil Aviation; Transport Aircraft; Lift; Wing Tips; Laminar Flow

19980064866

Airfoil analysis for horizontal axis wind turbines

Akmandor, I. S., Middle East Technical Univ., Turkey; Ekici, Kivanc, Middle East Technical Univ., Turkey; 1998, pp. 1-8; In English
Report No.(s): AIAA Paper 98-0020; Copyright; Avail: Aeroplus Dispatch

A numerical algorithm has been developed for 2D rotating and nonrotating airfoil cross sections. The steady Euler equations in the rotational plane with viscous boundary layer correction have been used for the analysis. The effects of boundary layers and wakes on the inviscid main stream flow are modeled by the displacement thickness concept. Both laminar and turbulent boundary layer thickness growth over the airfoil can be modeled. The transition point is input to the solution. The nonlinear Euler-boundary layer system of equations is in an integral conservative form and allows the correct treatment of shock waves. The system is first linearized and then solved implicitly by a Newton-Raphson technique. The RAE 2822 airfoil is used as a test case, and good agreement is obtained for the pressure coefficient and the boundary layer thickness distributions. The solver is also successfully used in calculating the flow around an FFA-WI-242 horizontal axis wind turbine airfoil.
Author (AIAA)
Wind Turbines; Horizontal Orientation; Axes of Rotation; Airfoil Profiles; Euler Equations of Motion; Boundary Layer Flow

19980064867

A 3-D stall-delay model for horizontal axis wind turbine performance prediction

Du, Zhaohui, Illinois, Univ., Urbana, USA; Selig, Michael S., Illinois, Univ., Urbana; 1998, pp. 9-19; In English

Report No.(s): AIAA Paper 98-0021; Copyright; Avail: Aeroplus Dispatch

This paper describes and analyzes the fundamental flow phenomena that characterize the boundary layer on rotating blades, and develops a preliminary stall-delay model that modifies the 2D airfoil data so as to simulate the 3D stall-delay effects. The following steps were taken in the development of the model: analysis of the 3D integral boundary-layer equations for a reference system rotating with the blade; description of the effects of rotor rotation on the separation point and its causes; and determination of a simple correction formula to obtain rotating rotor lift coefficient and drag coefficient data from measured 2D airfoil data. The preliminary 3D stall-delay model consists of two key parameters (the ratio of local chord to local radius and the ratio of rotation speed to freestream velocity) and three empirical correction factors (a, b, d). The stall-delay model is consistent with the blade element/momentum theory method and the Viterna/Tangler model, and the 3D stall-delay model can be incorporated into the state-of-the-art performance prediction codes, such as PROP.

Author (AIAA)

Wind Turbines; Aerodynamic Stalling; Three Dimensional Models; Horizontal Orientation; Axes of Rotation; Airfoil Profiles

19980064869

The stall flag method - Proof of concept

Corten, G. P., Netherlands Energy Research Foundation - Renewable Energy, Petten, Netherlands; 1998, pp. 31-43; In English

Report No.(s): AIAA Paper 98-0023; Copyright; Avail: Aeroplus Dispatch

A method for reliably measuring the stall behavior of large commercial wind turbines is presented. The method is based on a new detector: the stall flag (international patent pending). This ’stall flag method’ enables detailed visualization of the entire stalled area on large wind turbines. Meant to serve as ’proof of concept’, the stalled area of one blade of the 28-m diameter test turbine of ECN was visualized with 57 stall flags. Pasting the stall flags on this blade took only 3 h, proving high applicability on a middle-sized turbine (28-m diameter). Stall delay at the blade root was observed in both the radial and chordwise direction. The stall flag patterns revealed that the stall behavior was influenced by instrumentation used for other experiments. The stalled fraction of the swept area at 30-deg yaw turned out not to be shifted horizontally with respect to the rotor axis.

Author (AIAA)

Wind Turbines; Aerodynamic Stalling; Steady Flow; Flow Characteristics; Wind Velocity; Airfoil Profiles

19980064870

Dynamic stall and aerodynamic damping

Rasmussen, Flemming, Riso National Lab., Denmark; Petersen, Jorgen T., Riso National Lab., Denmark; Madsen, Helge A., Riso National Lab., Denmark; 1998, pp. 44-51; In English

Report No.(s): AIAA Paper 98-0024; Copyright; Avail: Aeroplus Dispatch

This paper gives a brief description of the dynamic stall model, and presents results from analyses of dynamic stall measurements for a variety of experiments with different airfoils in wind tunnel and on operating rotors. The wind tunnel experiments comprises pitching as well as plunging motion of the airfoils. The dynamic stall model is applied for derivation of aerodynamic damping characteristics for cyclic motion of the airfoils in the flapwise and edgewise direction combined with pitching. The investigation reveals that the airfoil dynamic stall characteristics depend on the airfoil shape and the type of motion (pitch, plunge). The aerodynamic damping characteristics, and thus the sensitivity to stall-induced vibrations, depend highly on the relative motion of the airfoil in the flapwise and edgewise direction, and on a possibly coupled pitch variation, which is determined by the structural characteristics of the blade.

Author (AIAA)

Aerodynamic Stalling; Dynamic Models; Wind Tunnel Tests; Turbine Blades; Airfoil Profiles; Vibration Damping

19980064873

Algorithm using spherical coordinates to calculate dynamic pressure from 5-hole pressure probe data

Freeman, J. B., National Renewable Energy Lab., USA; Robinson, M. C., National Renewable Energy Lab., USA; 1998, pp. 70-74; In English

Report No.(s): AIAA Paper 98-1063; Copyright; Avail: Aeroplus Dispatch

A five-hole static pressure probe is currently being used to characterize the inflow of the Combined Experiment Rotor experiment. A new algorithm has been developed to calculate dynamic pressure, angle-of-attack, and crossflow-angle from the pressure probe data. The new algorithm uses a version of the dynamic pressure calibration surface that has been transformed into spherical

coordinates. This simple transformation eliminates the need for an iterative solution process and is computationally stable. Improvements of four to five times in computational speed and the elimination of divergent solutions have been demonstrated.
Author (AIAA)
Wind Turbines; Dynamic Pressure; Spherical Coordinates; Pressure Measurement; Turbine Blades

19980064877

Navier-Stokes computations for an S809 airfoil with aerodynamic control devices

Papadakis, Michael, Wichita State Univ., USA; 1998, pp. 100-112; In English
Report No.(s): AIAA Paper 98-0033; Copyright; Avail: Aeroplus Dispatch

The flow about an S809 airfoil with two aerodynamic control devices, including a vented aileron and a spoiler-flap, was investigated with the compressible and incompressible Navier-Stokes equations. The one-equation turbulence models of Baldwin-Barth and Spalart-Allmaras were used to perform fully turbulent flow computations. Flow conditions included Mach number of 0.13, Reynolds number of 1 million based on airfoil chord, and angles of attack of 0, 6, 12, 27, 35, and 45 deg. Control deflections for this study were 60 and 90 deg for the spoiler-flap and -60 and -90 deg for the vented aileron. Most of the selected angles of attack and control deflections are representative of horizontal axis wind turbine conditions during aerodynamic braking. At these conditions the flow about the airfoil and control surface is unsteady and includes regions of extensive flow separation. The computational results were found to be in good qualitative agreement with the experimental data. In many cases, however, the magnitudes of the computed aerodynamic coefficients did not correlate well with the experiment.
Author (AIAA)
Wind Turbines; Turbine Blades; Airfoil Profiles; Wind Tunnel Tests; Spoiler Slot Ailerons; Control Surfaces

19980064916

A numerical simulation of wing-body junction flows

Krishnamurthy, R., North Carolina Agricultural and Technical State Univ., Greensboro, USA; Cagle, Corey D., North Carolina Agricultural and Technical State Univ., Greensboro; Chandra, S., North Carolina Agricultural and Technical State Univ., Greensboro; Georgiadis, Nicholas, NASA Lewis Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG3-1734
Report No.(s): AIAA Paper 98-1054; Copyright; Avail: Aeroplus Dispatch

Results from a numerical simulation of the turbulent flow past a wing-body junction are presented. The code NPARC has been used for the simulations which were performed on the C90 (CRAY Supercomputer) platform at National Aerodynamic Simulation facility (NAS). A three-dimensional multi-block structured grid was generated with appropriate clustering to capture the flow details. Comparisons were made with relevant experimental data from the literature. Good agreement between the numerical and experimental results has been found for mean velocities and skewed mean flow.
Author (AIAA)
Digital Simulation; Body-Wing Configurations; Turbulent Flow; Computational Fluid Dynamics; Baldwin-Lomax Turbulence Model

19980064964

Extremum system consisting of a rarefaction wave and a shock in a steady gas flow ***Ehkstremal'naya sistema volna razrezheniya - skachok uplotneniya v statsionarnom potoke gaza***

Omel'chenko, A. V., Baltijskij Gosudarstvennyj Tekhnicheskij Univ., Russia; Uskov, V. N., Baltijskij Gosudarstvennyj Tekhnicheskij Univ., Russia; PMTF - Prikladnaya Mekhanika i Tekhnicheskaya Fizika; Apr. 1997; ISSN 0869-5032; Volume 38, no. 2, pp. 40-47; In Russian; Copyright; Avail: Aeroplus Dispatch

The authors present a theoretical study of the steady uniform supersonic flow of a perfect gas which successively passes through a simple Prandtl-Meier rarefaction wave and a shock going in the same direction. Analytical solutions are presented which make it possible to determine the domain boundaries of the monotonic and nonmonotonic behavior of the gasdynamic variables behind the system as well as to calculate wave intensity values in the optimal system.
AIAA
Steady Flow; Rarefied Gas Dynamics; Supersonic Flow; Shock Wave Interaction; Supersonic Diffusers

19980064966

Application of the boundary element method and parametric polynomials in problems of the optimization of wing profiles ***Primenenie metoda granichnykh ehlementov i parametricheskikh polinomov v zadachakh optimizatsii krylevykh profilej***

Aul'chenko, S. M., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; Latypov, A. F., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; PMTF - Prikladnaya Mekhanika i Tekhnicheskaya Fizika; Apr. 1997; ISSN 0869-5032; Volume 38, no. 2, pp. 73-79; In Russian; Copyright; Avail: Aeroplus Dispatch

The authors present a method for the design of optimal two-dimensional aerodynamic configurations which includes a modified boundary element method for solving the external flow problems. Attention is given to examples of the application of this method to the design of subsonic wing profiles.

AIAA

Wing Profiles; Boundary Element Method; Polynomials; Inviscid Flow; Green'S FUNCTIONS

19980064968

Calculation study of a viscous shock layer on a plate ***Raschetnoe issledovanie vyazkogo udarnogo sloya na plastine***

Poplavskaya, T. V., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; Vetlutskij, V. N., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; PMTF - Prikladnaya Mekhanika i Tekhnicheskaya Fizika; Apr. 1997; ISSN 0869-5032; Volume 38, no. 2, pp. 91-100; In Russian; Copyright; Avail: Aeroplus Dispatch

A viscous shock layer model is used to study the hypersonic flow past a plate with a sharp leading edge. All the flow characteristics are calculated for the plate at zero angle of attack in a wide range of Mach and Reynolds numbers. Parametric studies indicate that the viscous shock layer model used here provides a good description of the hypersonic flow past a plate both at high Reynolds numbers (Re sub x of about 10 exp 6) and at moderate Reynolds numbers (Re sub x of about 10 exp 4), where Re sub x is the local Reynolds number.

AIAA

Viscous Flow; Flat Plates; Shock Layers; Hypersonic Flow; Interactional Aerodynamics

19980064969

Pressure field from a uniformly loaded rectangular wing in a supersonic flow ***Pole davlenij ot ravnomerno nagruzhennogo pryamougol'nogo kryla v sverkhzvukovom potoke***

Vorob'ev, N. F., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; PMTF - Prikladnaya Mekhanika i Tekhnicheskaya Fizika; Apr. 1997; ISSN 0869-5032; Volume 38, no. 2, pp. 101-106; In Russian; Copyright; Avail: Aeroplus Dispatch

Formulas characterizing the pressure field from a uniformly loaded rectangular-planform wing are presented in the form of elementary functions. This result can be used to develop an inverse-problem-solution algorithm for wings of complex planform in the case where the wing projection on the base plane is divided into rectangular cells.

AIAA

Supersonic Flow; Pressure Distribution; Rectangular Wings; Wing Loading; Aerodynamic Characteristics; Thin Wings

19980064971

Experimental study of the nonlinear development of instability waves on a flat plate at a Mach number of 3 ***Ehksperimental'noe issledovanie nelinejnogo razvitiya voln neustojchivosti na ploskoj plastine pri chisle Makha M=3***

Ermolaev, Yu. G., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; Kosinov, A. D., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; Semenov, N. V., RAN, Inst. Teoreticheskoj i Prikladnoj Mekhaniki, Russia; PMTF - Prikladnaya Mekhanika i Tekhnicheskaya Fizika; Apr. 1997; ISSN 0869-5032; Volume 38, no. 2, pp. 107-114; In Russian; Copyright; Avail: Aeroplus Dispatch

The nonlinear development of instability waves in a supersonic boundary layer on a flat plate at M = 3.0 was investigated in a supersonic wind tunnel. Linear stability theory cannot explain the observed appearance of rapidly intensifying quasi-two-dimensional and three-dimensional waves. Using nonlinear theory, however, it can be assumed that increments for two-dimensional and slightly oblique waves in the supersonic boundary layer can be substantially greater than those for strongly three-dimensional waves.

AIAA

Flat Plates; Surface Waves; Unsteady Aerodynamics; Boundary Layer Transition; Vortices; Flow Distortion

19980065084

Solution adaptive Cartesian grid methods for aerodynamic flows with complex geometries

Aftosmis, Michael J., NASA Ames Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Cartesian methods for CFD offer an accurate and robust approach for simulating aerodynamic flows around geometrically complex bodies. As a result of this flexibility, the quantity of literature devoted to their study has grown substantially in recent years. These notes attempt to cover only a subset of this on-going research. In doing so, however, they aim to provide insight into the fandamental challenges faced by practitioners of the approach, while also serving as a guide for further exploration. The

integration schemes used in Cartesian solvers are similar to those used in other approaches. Therefore, these notes focus mainly on the geometric algorithms, surface modeling, and boundary conditions needed to design a successful Cartesian mesh scheme.
Author (AIAA)
Computational Grids; Flow Geometry; Cartesian Coordinates; Computational Fluid Dynamics; Grid Generation (Mathematics); Inviscid Flow

19980065086
Hybrid structured/unstructured grid generation for high-Reynolds number flows
Carette, J.-C., von Karman Inst. for Fluid Dynamics, Belgium; Deconinck, H., von Karman Inst. for Fluid Dynamics, Belgium; 1997; In English; Copyright; Avail: Aeroplus Dispatch

At the high Reynolds numbers encountered in typical aerodynamical applications, the viscous effects are felt essentially in the very thin boundary layers that develop along the solid walls and in the wakes. The efficient capture of these thin viscous layers requires a locally highly stretched mesh while an isotropic mesh is desired in the nearly inviscid regions of the flow. The generation of highly stretched unstructured meshes is not an easy task since triangles with very large obtuse angles have to be avoided. In the present work, we have developed an automatic hybrid structured/unstructured technique which combines a flexible point distribution method similar to that of Ashford and Powell (1995), a robust hyperbolic grid generation module that produces high-quality semi-structured grids and a new quadtree frontal Delaunay method which associates a frontal Delaunay method with a background quadtree for the generation of smooth and regular unstructured meshes.
Author (AIAA)
Grid Generation (Mathematics); High Reynolds Number; Computational Fluid Dynamics; Aspect Ratio; Trees (Mathematics)

19980065115
Numerical simulation of hypersonic re-entry flow
Shinjo, Junji, Tokyo, Univ., Japan; 1997, pp. 85-91; In English
Report No.(s): AAS Paper 97-407; Copyright; Avail: Aeroplus Dispatch

A numerical simulation of a hypersonic thermochemical nonequilibrium flow is presented. The flow models considered here are based on 11-species chemical reactions and Park's two-temperature model. Flow conditions correspond to a flow around a blunt body flying at Mach 24.8 at an altitude of 78 km. The calculated heat flux to the body is approximately 0.12 MW/sq m at the stagnation point.
Author (AIAA)
Digital Simulation; Hypersonic Flow; Nonequilibrium Flow; Aerothermochemistry; Reentry

19980065381
Three-dimensional turbine rotor forcing functions and linear theory analysis
Johnston, David A., Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 183-189; In English; Copyright; Avail: Aeroplus Dispatch

Many turbomachine flowfields are inherently three dimensional. Often, however, the data and methods used to analyze the unsteady aerodynamic forcing functions generated by these blade rows are two dimensional. This paper is directed at developing a three-dimensional compressible flow forcing-function modeling technique to split forcing-function data into vortical and potential components. This is accomplished by extending current state-of-the-art two-dimensional methods to three dimensions in cylindrical coordinates. Three-dimensional unsteady forcing-function data, both unsteady pressure and velocity, generated by the first rotor of a low-speed, two-stage research turbine are used in the model development. Both the three-dimensional model developed herein and a two-dimensional model are then applied to the turbine rotor data. For the potential perturbation velocity, the three-dimensional method agrees well with the two-dimensional strip theory method in terms of both velocities and axial decay factors. For the vortical perturbation velocity, the correlations were inconsistent with the two-dimensional theory in that the vortical proportionality constant was not constant and the phasing of the velocity components was not zero.
Author (AIAA)
Turbomachinery; Rotor Dynamics; Three Dimensional Models; Aerodynamic Characteristics

19980065382
Measured rotor wake and potential forcing functions, including blade row interactions
Johnston, Robert T., Purdue Univ., USA; Feiereisen, John M., Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 191-198; In English; Copyright; Avail: Aeroplus Dispatch

A fundamental experiment is directed at the acquisition and analysis of data defining compressible forcing functions generated by a rotor, including interactions with the upstream-generated inlet guide vane (IGV) wakes, for application to wake forcing function models in turbomachine forced-response design systems. The research fan facility consists of an IGV row and a downstream rotor. IGV-rotor axial spacing is variable, with the IGV row able to be indexed circumferentially, thereby enabling the rotor wakes to be measured both in the IGV freestream and wakes. At a rotor-relative Mach number of 0.6 unsteady measurements are made of the rotor wake pressure and velocity fields for two IGV-rotor axial spacings and with the rotor wake measured in the IGV freestream and wake regions. The decay characteristics of the rotor blade wakes are compared to empirical correlations. After Fourier decomposition, a vortical-potential gust splitting analysis is implemented and applied to the first-harmonic data to determine the vortical and potential harmonic wake gust forcing functions both upstream and downstream of the rotor. The potential gust component of the rotor wakes upstream of the rotor is found to be dominated by the first-harmonic component with small contributions from the second and third harmonics. Higher harmonics of the vortical gust component of the rotor wakes measured both in and out of the IGV wakes are found to be significantly reduced in the IGV wake regions.
Author (AIAA)
Rotor Blades (Turbomachinery); Rotor Dynamics; Wakes; Aerodynamic Forces; Mathematical Models

19980065384
Blading response to potential field interactions in axial- and radial-flow turbomachinery
Sanders, Albert J., Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 199-207; In English; Copyright; Avail: Aeroplus Dispatch

An unsteady aerodynamic model is developed to predict the response of both axial- and radial-flow turbomachinery blading resulting from potential field interactions. For axial-flow turbomachines this is accomplished by extending a compressible flat-plate cascade analysis to account for the induced velocities due to an adjacent blade row's potential field. The blading response in a radial cascade consisting of logarithmic spiral airfoils is then calculated utilizing a conformal transformation mapping of the radial geometry to an equivalent axial cascade, enabling existing axial cascade models to be used for radial-flow turbomachine blade rows. This model is then used to demonstrate the forced response characteristics of a blade row to potential fields of both upstream and downstream airfoil rows and to upstream blade-row-generated vortical wakes, including the differences between the response of axial- and radial-flow turbomachinery blading. For both the axial- and radial-flow blade rows, the nondimensional unsteady aerodynamic response amplitudes generated by airfoil row potential and vortical wake-forcing functions were of the same order of magnitude. Thus, for closely spaced, highly loaded blade rows, both wake and potential field interactions may be of equal significance.
Author (AIAA)
Rotor Blades (Turbomachinery); Axial Flow Turbines; Radial Flow; Dynamic Response; Potential Fields

19980065388
Wake decay - Effect of freestream swirl
Brookfield, J. M., MIT, USA; Waitz, I. A., MIT, USA; Sell, J., MIT, USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 215-224; In English
Contract(s)/Grant(s): NAG1-1512; Copyright; Avail: Aeroplus Dispatch

A study of the effects of freestream swirl on the decay characteristics of wakes shed from a rotating blade row is presented. The freestream swirl behind the rotor causes the wakes to skew tangentially, stretching the wakes as they are convected from the rotor to the stator. The effect of stretching on wake decay is illustrated using a simplified two-dimensional model. The model is described and the results are compared to 1) measurements from a two-dimensional cascade facility where no stretching or skewing of the wakes occurs; 2) solutions obtained using a three-dimensional, Reynolds-averaged Navier-Stokes solver; and 3) experimental wake measurements taken behind a low hub-to-tip ratio fan. For typical fan geometries with hub-to-tip ratios of approximately 0.5 and rotor-stator spacings of one to two rotor chord lengths, the wake can be stretched by over 50 percent. The stretching increases the mixing rate, which leads to a reduction in the mean wake velocity deficit of approximately 30 percent and a widening of the wake of about 15 percent. These effects account for much of the difference seen between cascade wake measurements and those taken behind rotating fan blade rows. It is therefore important to include the effects of stretching when using cascade data for prediction of fluid mechanic, acoustic, or structural phenomena associated with fan wakes. Finally, the study also suggests a potential for small (less than 3 dB) reductions in tonal noise because of wake-stator interaction through tailoring the fan loading distribution to produce particular spanwise wake decay characteristics.
Author (AIAA)
Rotor Blades (Turbomachinery); Turbulent Wakes; Free Flow; Two Dimensional Models

19980065390

Aerodynamic shape optimization of a subsonic inlet using three-dimensional Euler computation

Reddy, D. R., NASA Lewis Research Center, USA; Reddy, E. S., NYMA, Inc., USA; Moody, R. E., Boeing Co., USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 225-233; In English

Contract(s)/Grant(s): NAS5-25266; Copyright; Avail: Aeroplus Dispatch

A design optimization study of a subsonic inlet is presented where the peak Mach number at cruise condition on the inside of the inlet surface is the objective function to be minimized and inlet lip shape parameters are the design variables. The peak Mach number at takeoff, rolling takeoff, static, and crosswind conditions are constrained to an upper limit. The three-dimensional flowfield is predicted by the NPARC computational fluid dynamics code in Euler mode. A GRAPE- (grids about airfoils using Poisson's equation) based three-dimensional grid generator is employed to generate a C-grid around the inlet. Constrained numerical optimization is carried out by interfacing NPARC with the automated design synthesis optimization code. The constrained optimum is obtained by the method of feasible directions. The required gradients for optimization are computed via forward difference scheme. At the baseline (initial) design, takeoff, rolling takeoff, and crosswind conditions have their peak Mach numbers exceeding the upper bounds. However, at the constrained optimum design, only the upper limit on the takeoff peak Mach number is found to be critical with no appreciable change in cruise Mach number.

Author (AIAA)

Inlet Flow; Subsonic Flow; Three Dimensional Flow; Computational Fluid Dynamics; Euler Equations of Motion

19980065392

Overexpanded two-dimensional convergent-divergent nozzle performance, effects of three-dimensional flow interactions

Hamed, A., Cincinnati, Univ., USA; Vogiatzis, C., Cincinnati, Univ., USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 234-240; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents computational results for the flowfield, surface pressure distribution, and internal thrust coefficient of a two-dimensional convergent-divergent nozzle, and compares them with existing experimental results over a range of nozzle pressure ratios (NPRs), including overexpanded conditions. The numerical simulations are based on the implicit solution of the compressible Navier-Stokes equations and the two-equation kappa-omega turbulence model in conservation law form and general curvilinear coordinates. The solution domain is extended laterally outside the nozzle as well as upstream and downstream of the nozzle exit to simulate the effects of external interactions. Computational results indicate that at overexpanded conditions, flow entrainment into the nozzle occurs mostly over the flaps, and that a strong secondary flow traverses the endwalls, behind the shock. Strategies for flow prediction accuracy and computational efficiency over a wide range of overexpanded NPRs are recommended, based on the assessment of computational results from both three-dimensional and two-dimensional simulations.

Author (AIAA)

Convergent-Divergent Nozzles; Nozzle Flow; Two Dimensional Flow; Three Dimensional Flow; Computational Fluid Dynamics

19980065431

Chaos in wraparound fin projectile motion

Asrar, W., Aligarh Muslim Univ., India; Baig, M. F., Aligarh Muslim Univ., India; Khan, S. A., Aligarh Muslim Univ., India; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 354-356; In English

Report No.(s): AIAA Paper 96-0066; Copyright; Avail: Aeroplus Dispatch

The present numerical study of the nonlinear dynamics of wraparound fin projectiles in the framework of chaos theory attempts to identify the boundaries of periodic, quasi-periodic, and chaotic motions. Also defined are whether roll-pitch resonance lock-in occurs, through phase-portrait analysis, and the possibility of activating roll breakout by controlling the rotation number.

AIAA

Finned Bodies; Chaos; Projectiles; Missile Control; Dynamic Stability

19980065473

Simulation of a controlled airfoil with jets

Allan, Brian G., NASA Langley Research Center, USA; Holt, Maurice, California, Univ., Berkeley; Packard, Andrew, California, Univ., Berkeley; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 257-263; In English

Contract(s)/Grant(s): NAS1-19480; NGT-51030; NCA2-782; NCC2-5035

Report No.(s): AIAA Paper 97-0100; Copyright; Avail: Aeroplus Dispatch

Numerical simulations of a 2D airfoil controlled by an applied moment in pitch and an airfoil controlled by jets, were investigated. These simulations couple the Reynolds-averaged Navier-Stokes equations and Euler's equations of rigid-body motion,

along with an active control system. Controllers for both systems were designed to track altitude commands and were evaluated by simulating a closed-loop altitude step response using the coupled system. The airfoil controlled by a pitching moment used an optimal state feedback controller. A closed-loop simulation of the airfoil with an applied moment showed that the trajectories compared very well with quasi-steady aerodynamic theory, providing a measure of validation. The airfoil with jets used a controller designed by robust control methods. A linear plant model for this system was identified using open-loop data generated by the nonlinear coupled system. A closed-loop simulation of the airfoil with jets showed good tracking of an altitude command. This simulation also showed oscillations in the control input as a result of dynamics not accounted for in the control design. This research work demonstrates how CFD, coupled with rigid-body dynamics and a control law, can prototype control systems in problematic nonlinear flight regimes.
Author (AIAA)
Digital Simulation; Airfoil Profiles; Jet Flow; Aircraft Control; Aircraft Models

19980066877

Influence of the Mach number on boundary layer transition by a Ludwieg tube set-up

Schook, R., Eindhoven Univ. of Technology, Netherlands; Hogendoorn, C. J., Eindhoven Univ. of Technology, Netherlands; de Lange, H. C., Eindhoven Univ. of Technology, Netherlands; van Steenhoven, A. A., Eindhoven Univ. of Technology, Netherlands; 1997, pp. 229-236; In English; Copyright; Avail: Aeroplus Dispatch

The effect of compressibility on boundary layer transition is studied by using a Ludwieg tube set-up. Heat transfer experiments are performed at a flat plate using thin film gauges. The experiments are done with Mach numbers ranging from 0.13 to 0.56. The dimensions of the turbulence grid are not changed. This results in a decrease of the turbulence level with increasing Mach number. No significant change of transition start or transition length as a function of the Mach number is observed. However, as measured separately, the turbulence level has a significant influence on both above-mentioned transition parameters. It is concluded that turbulence level and Mach number have an opposite effect on boundary layer transition.
Author (AIAA)
Shock Tubes; Boundary Layer Transition; Mach Number; Turbulent Boundary Layer; Compressibility Effects; Turbulent Heat Transfer

19980067073

Computing some special two-dimensional separation flows with Euler equations

Tang, Zhili, Nanjing Univ. of Aeronautics and Astronautics, China; Huang, Mingque, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1005-2615; Volume 29, no. 4, pp. 460-463; In Chinese; Copyright; Avail: Aeroplus Dispatch

Separation flows passing two sorts of blunt bodies are investigated numerically by unsteady Euler equations and the implicit finite difference scheme. The first sort is the transonic flow passing a circular cylinder. The computation reveals the low separation induced by the shock wave and the separation vortices shedding downstream periodically. The other kind is a cylinder with sharp corner, such as that with triangular or semicircular cross section. The separation vortices shedding as a form of Karman vortex street from the sharp corner are also revealed. For these bodies, the present computation gives the average drag coefficients, and the Strouhal number is related to the shedding frequency of the separation vortices and the flow pattern. They are all in good agreement with the experiments.
Author (AIAA)
Two Dimensional Flow; Separated Flow; Euler Equations of Motion

19980067114

Performance prediction of bowed vane axial-flow turbines

Yu, Qing, Nanjing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 385-388; In Chinese; Copyright; Avail: Aeroplus Dispatch

A method for the performance prediction of axial-flow turbines with bowed and conventional vanes is presented which uses the flow function as a control equation on the S2 surface. Profile loss is calculated by a numerical method on several S1 flow surfaces. Secondary loss and tip-leakage loss are empirically estimated with pitch-wide average losses along the cascade blades. The effect of the blade bow angle on the secondary loss is taken into account. A comparison of the predicted results with experimental data confirms the feasibility of the method.
Author (AIAA)
Turbocompressors; Vanes; Secondary Flow; Cascade Flow; Blade Tips

19980067122

Effects of film cooling on internal heat transfer coefficients of blades

Tao, Zhi, Beijing Univ. of Aeronautics and Astronautics, China; Cai, Yi, Chinese Gas Turbine Establishment, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 413-415; In Chinese; Copyright; Avail: Aeroplus Dispatch

Effects of film cooling on the internal heat transfer coefficients of turbine blades were investigated numerically, and the key factors were determined to be the film cooling hole distance ratio and the inlet Reynolds number. The local heat transfer coefficient variations are discussed both for the pressure and the suction sides of blades. Numerical results show that, for the pressure side, the internal heat transfer coefficient is much enhanced and can be doubled, as compared with the no-hole passages in the same range. The heat transfer coefficient for the suction side, however, is decreased due to film cooling.

Author (AIAA)

Turbine Blades; Aerodynamic Heat Transfer; Heat Transfer Coefficients; Film Cooling; Inlet Flow; Suction

19980067127

Thrust characteristics of exhaust ejector systems with lobed nozzles tested at cold high speed conditions

Li, Li, Beijing Univ. of Aeronautics and Astronautics, China; Wu, Shousheng, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 429-432; In Chinese; Copyright; Avail: Aeroplus Dispatch

A set of thrust characteristics (thrust with nozzle pressure) of a round convergent nozzle, five lobed nozzles, and lobed nozzle-mixing tube combinations with and without diffusers have been obtained from an experimental investigation at cold high speed conditions (nozzle pressure = 0.15-0.5 MPa). Test results show that the lobed nozzles of exhaust ejector systems at high speed conditions also have superior application prospects, provided their designs consider the impact of high speed flow, particularly, the aerodynamic characteristics of supersonic exhaust flow.

Author (AIAA)

Nozzle Flow; Exhaust Systems; Thrust Measurement; Cold Flow Tests; Fluid Pressure; Flow Velocity

19980067157

Numerical modelling of unsteady flow in a twin side-by-side intake system

Causon, D. M., Manchester Metropolitan Univ., UK; Ingram, D. M., Manchester Metropolitan Univ., UK; Aeronautical Journal; Oct. 1997; ISSN 0001-9240; Volume 101,, no. 1008, pp. 365-370; In English; Copyright; Avail: Aeroplus Dispatch

The unsteady flow field in a twin side-by-side intake arrangement arising as a result of a surge in one of the engines has been studied numerically by solving the Euler equations. Unsteadiness was introduced by prescribing a pressure disturbance at the exit plane of one of the intakes. The two cases considered correspond to static ground-running of the engines and a flight Mach number of 0.6 with a single rapidly increasing exit plane pressure disturbance representative of a pop surge. The amplitude of the imposed pressure disturbance varied between 100 and 200 percent of the mean exit static pressure. In the cases considered, the results indicate that static pressure attenuation of the propagating hammer shock occurs upstream of the intake entry plane, resulting in a relatively weak rarefaction wave traveling down the adjacent intake. No evidence of increased dynamic flow distortion likely to lead to a complementary surge in the adjacent engine was observed. These conclusions have been confirmed by available test data, thus demonstrating the value of CFD techniques for modeling complex unsteady transient flow phenomena of this type.

Author (AIAA)

Unsteady Flow; Intake Systems; Pressure Distribution; Mathematical Models

19980067172

Influence of asymmetric excrescences on the cross-flow around a circular cylinder

Nigim, Hani H., Birzeit Univ., Jordan; Japan Society for Aeronautical and Space Sciences, Transactions; Nov. 1997; ISSN 0549-3811; Volume 40,, no. 129, pp. 171-184; In English; Copyright; Avail: Aeroplus Dispatch

The effect of asymmetrically distributed excrescences around a circular cylinder on the cross-flow was studied experimentally. The investigation was conducted for four models in a low-speed wind tunnel, where a Reynolds number of 30,000 based upon the base cylinder diameter was obtained. Local surface pressure, body forces, and near wake characteristics were evaluated. The results reveal that variations on the angular position as well as the excrescence density of the tested models induced considerable alterations on measured parameters. Correlations between the body and the near wake parameters were established.

Author (AIAA)

Protuberances; Cross Flow; Circular Cylinders; Bluff Bodies; Separated Flow; Fluid Dynamics

19980067175

Control of a falling body with a mathematical model for unsteady aerodynamic force

Hamidi, Hessamiddin E., Nagoya Univ., Japan; Nakamura, Yoshiaki, Nagoya Univ., Japan; Japan Society for Aeronautical and Space Sciences, Transactions; Nov. 1997; ISSN 0549-3811; Volume 40,, no. 129, pp. 207-220; In English; Copyright; Avail: Aeroplus Dispatch

Motion of a freely oscillating body like pendulum has been measured, modeled, and controlled. This problem models oscillation of a falling body with parachute, which is subject to gravitational and aerodynamic forces. We have used a wind tunnel with its exit section vertically inclined, where a model can oscillate about a fixed joint above the exit. Two air jets were employed to control the oscillation and emitted in the direction of motion or in the opposite direction. The aerodynamic force has great influence on damping the oscillation, where damping force becomes more effective as the flow speed increases. It was found that, at higher reduced frequencies, hysteresis is observed in the relation between pressure distribution around the model and attack angle. From the data obtained by experiments, a mathematical model has been proposed for the present system, and its stability is analyzed based on this model. Consequently it turned out that the wind velocity and the aerodynamic coefficients of model play important roles in the stability.

Author (AIAA)

Mathematical Models; Unsteady Aerodynamics; Aerodynamic Forces; Falling; Pendulums; Wind Tunnel Tests

19980067353

Reacting flow establishment in ram accelerators - A numerical study

Yungster, S., NASA Lewis Research Center, USA; Radhakrishnan, K., NASA Lewis Research Center, USA; Rabinowitz, M. J., NASA Lewis Research Center, USA; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 10-17; In English; Copyright; Avail: Aeroplus Dispatch

The temporal evolution of the combustion process that is established during projectile transition from the launch tube into the ram accelerator section containing an explosive hydrogen-oxygen-argon gas mixture is examined. The Navier-Stokes equations for chemically reacting flow are solved in a fully coupled manner, using an impliclt, time-accurate algorithm. The solution procedure is based on a spatially second-order, total variation diminishing scheme and a temporally second-order, variable-step, backward-differentiation formula method. The hydrogen-oxygen-argon chemistry is modeled with a nine-species, 19-step reaction mechanism. Results of the numerical simulations are presented for two representative cases. We study the temporal developments of shock-induced combustion and thrust force. Positive thrust occurs in both ram accelerator configurations presented; however, combustion in the boundary layer enhances its separation, ultimately resulting in unstart.

Author (AIAA)

Ram Accelerators; Reacting Flow; Digital Simulation; Computational Fluid Dynamics; Detonable Gas Mixtures

19980067364

Numerical investigation of inlet buzz flow

Lu, Pong-Jeu, National Cheng Kung Univ., Taiwan, Province of China; Jain, Ling-Tzong, National Cheng Kung Univ., Taiwan, Province of China; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 90-100; In English; Copyright; Avail: Aeroplus Dispatch

The present research aims at developing a time-accurate, high-resolution total variation diminishing scheme and a data-processing procedure that can analyze the inlet buzz flow problem. Special care has been exercised on the numerical buzz flow initiation procedure to minimize the generation of spurious numerical waves. A 10-ft ramjet engine was adopted as the simulation model. The simulated results show that the buzz cycle is attributed both to the local flow instability around the entrance and to the acoustic resonance modes appearing inside the plenum chamber. A revised upstream feedback mechanism is proposed in the present work. It was found that the feedback loop for the subcritical operation is established locally around the inlet region, in which the reflected acoustic waves were sent upstream as a result of the impingement of the shock-induced separation vorticities on the centerbody surface and/or the cowl lip. For the supercritical operation, however, the formation of the feedback mechanism is ascribed to the fundamental acoustic resonance mode generated in the plenum chamber.

Author (AIAA)

Inlet Flow; TVD Schemes; Data Processing; Computational Fluid Dynamics; Flutter Analysis

19980067366

Experimental analysis of the turbulent shear stresses for distorted supersonic boundary layers

Luker, Joel J., USAF, Inst. of Technology, USA; Hale, Chad S., USAF, Inst. of Technology, USA; Bowersox, Rodney D. W., USAF, Inst. of Technology, USA; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 110-118;

In English; Copyright; Avail: Aeroplus Dispatch

An experimental analysis of the turbulent shear stresses for a supersonic boundary layer distorted by streamline curvature-induced pressure gradients was performed using LDV. Four pressure-gradient flows were examined: a nominally zero-pressure-gradient case; a favorable-pressure gradient; an adverse-pressure gradient; and a successive-pressure gradient. For the favorable-pressure gradient, the turbulent shear-stress levels across the boundary layer decreased by 70-100 percent, as compared to the zero-pressure-gradient boundary layer. For the adverse-pressure gradient, a 70-100 percent increase was observed. For the combined-pressure gradient, the shear stresses returned to values similar to the zero-pressure-gradient flow. A new pressure gradient parameter was found to correlate well with the peak shear-stress amplification. The combined-pressure-gradient flow demonstrated that the turbulent structure adjusts relatively rapidly to the distortion. Numerical simulations of the mean velocity obtained with a k-omega turbulence model were found to agree very well with the present data.

Author (AIAA)

Shear Stress; Turbulent Flow; Supersonic Boundary Layers; Flow Distortion; Pressure Gradients; Flow Measurement

19980067547

High-performance supersonic missile inlet design using automated optimization

Zha, Ge-Cheng, Rutgers Univ., USA; Smith, Donald, Rutgers Univ., USA; Schwabacher, Mark, Rutgers Univ., USA; Rasheed, Khaled, Rutgers Univ., USA; Gelsey, Andrew, Rutgers Univ., USA; Knight, Doyle, Rutgers Univ., USA; Haas, Martin, United Technologies Research Center, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 697-705; In English
Contract(s)/Grant(s): DABT63-93-C-0064; Copyright; Avail: Aeroplus Dispatch

A multilevel design strategy for supersonic missile inlet design is developed. The multilevel design strategy combines an efficient simple physical model analysis tool and a sophisticated CFD Navier-Stokes analysis tool. The efficient simple analysis tool is incorporated into the optimization loop, and the sophisticated CFD analysis tool is used to verify, select, and filter the final design. The genetic algorithms and multistart gradient line search optimizers are used to search the nonsmooth design space. A geometry model for the supersonic missile inlet is developed. A supersonic missile inlet that starts at Mach 2.6 and cruises at Mach 4 was designed. Significant improvement of the inlet total pressure recovery has been obtained. Detailed flow-field analysis is also presented.

Author (AIAA)

Supersonic Inlets; Missile Design; Computer Aided Design; Genetic Algorithms; Navier-Stokes Equation

19980067548

Method for the constrained design of natural laminar flow airfoils

Green, Bradford E., George Washington Univ., USA; Whitesides, John L., George Washington Univ., USA; Campbell, Richard L., NASA Langley Research Center, USA; Mineck, Raymond E., NASA Langley Research Center, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 706-712; In English; Copyright; Avail: Aeroplus Dispatch

An automated iterative design method has been developed by which an airfoil with a substantial amount of natural laminar flow can be designed while maintaining other aerodynamic and geometric constraints. Drag reductions have been realized using the design method over a range of Mach numbers, Reynolds numbers, and airfoil thicknesses. The key features of the method are the compressible linear stability analysis code used to calculate N-factors; the ability to calculate a target N-factor distribution that forces the flow to undergo transition at the desired location; the target pressure/N-factor relationship that is used to modify target pressures to produce the desired N-factor distribution; and its ability to design airfoils to meet lift, pitching moment, thickness, and leading-edge radius constraints while also being able to meet the natural laminar flow constraint.

Author (AIAA)

Laminar Flow Airfoils; Drag Reduction; Aerodynamic Configurations; Leading Edges; Aircraft Design; Pitching Moments

19980067549

Supersonic transitional airfoil shapes of minimum drag

Fedorov, A. V., Moscow Inst. of Physics and Technology, Russia; Malmuth, N. D., Rockwell International Science Center, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 713-718; In English
Contract(s)/Grant(s): F49620-96-C-0004; Copyright; Avail: Aeroplus Dispatch

The feasibility of a procedure incorporating transition considerations in optimizing total drag is demonstrated. The Schittkowski algorithm was modified to demonstrate the approach on 2D airfoils. Cubic spline basis functions were used to describe the airfoils, and total drag (wave + friction) was minimized under the constraint of a fixed airfoil area. Reynolds numbers were assumed such that the airfoil was transitional, generally with the forward portion laminar and the aft turbulent. The transition locus was calculated using the fast transition prediction module, which provides rapid computation of the Tollmien-Schlichting wave amplification factor N and estimates transition point by the eN method. The laminar friction drag was evaluated using self-similar solutions of the boundary-layer equations. The friction drag for the turbulent portion was computed assuming a one-seventh velocity profile. With this framework, the total drag was a function of the functional x(tr), the streamwise location of transition. As a validation of the method, the algorithm gave the correct global optimum for the inviscid case, which is the parabolic arc profile. For the viscous case, significantly different locations of the maximum thickness led to only small differences in the minimum total drag.

Author (AIAA)

Supersonic Flow; Airfoil Profiles; Minimum Drag; Transition Flow; Boundary Layer Equations; Tollmien-Schlichting Waves

19980067550

Unsteady aerodynamics of airfoils encountering traveling gusts and vortices

Leishman, J. G., Maryland, Univ., College Park, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 719-729; In English; Copyright; Avail: Aeroplus Dispatch

By means of the reverse flow theorems, results are obtained for the unsteady lift and pitching moment on 2D airfoils penetrating sharp-edged traveling gusts. Both downstream and upstream traveling gusts are considered. For the incompressible case, exact results are given and are generalized numerically for any gust field by means of Duhamel superposition. Results are then given for the airloads and acoustics generated by a 2D airfoil encountering a vortex convecting at different gust speed ratios. Numerical results for the traveling sharp-edged gust problem are also derived for subsonic flows by means of exact linear theory. Further results for the subsonic case are computed by means of a Euler finite difference method. It is found that the gust speed ratio has substantial effects on the unsteady airloads and will be an important parameter to represent in helicopter rotor aeroacoustic problems.

Author (AIAA)

Unsteady Aerodynamics; Airfoil Profiles; Blade-Vortex Interaction; Gust Loads; Pitching Moments; Lift

19980067552

Different wings flowfields interaction on the wing-propeller coupling

Ardito Marretta, Rosario M., Palermo, Univ., Italy; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 740-747; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes high-portability numerical technique based on the method of free wake analysis (FWA) that analyzes the interference between an aircraft propeller and a wing having different planforms and computes the influence of the wing aerodynamic field on the propeller performance. For an isolated propeller and wing, the models employed are based on the FWA and Prandtl theory, respectively. The performance of the propeller in the presence of the wing is related to the wing angle of attack and to the variation of wing circulation and the corresponding induced velocity at the propeller disk. A numerical model, previously and successfully used, was implemented to account for the effects of a wing on the wing-propeller coupling. to test the robustness of the method, the available experimental data obtained on a scale model of an isolated propeller are used. In a correlation study, the results, when wing and propeller are coupled, show the sensitivity of thrust, power, and efficiency to inflow conditions and blade pitch, as well as to the wing planform.

Author (AIAA)

Propeller Blades; Flow Distribution; Wing Planforms; Interactional Aerodynamics; Propeller Efficiency

19980067553

In-flight boundary-layer state measurements on a high-lift system - Slat

van Dam, C. P., California, Univ., Davis, USA; Los, S. M., California, Univ., Davis; Miley, S. J., Old Dominion Univ., USA; Roback, V. E., NASA Langley Research Center, USA; Yip, L. P., NASA Langley Research Center, USA; Bertelrud, A., Analytical Services and Materials, Inc., USA; Vijgen, P. M. H. W., High Technology Corp., USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 748-756; In English

Contract(s)/Grant(s): NAS1-19858; NAS1-19864; NAS1-19299; NCC1-163; NCC1-207; Copyright; Avail: Aeroplus Dispatch

Flight experiments on NASA/Langley’s B737-100 airplane were conducted to document flow characteristics for further understanding of high-lift flow physics. The measurements included surface pressure distributions measured using flush pressure taps and pressure belts on the slats, main element, and flap elements, and boundary-layer state changes measured using hot-film anemometry and IR thermography. In this paper, results obtained in the final phase of flight experiments are presented and analyzed. The analysis primarily focuses on changes in the boundary-layer state measured on the slat as a result of changes in flap setting and/or flight condition. The measurements show that extended runs of laminar flow exist on the slat at relevant angles of

attack. Flow mechanisms that affect the extent of laminar flow include attachment-line contamination, crossflow instability, and relaminarization.
Author (AIAA)
Boeing 737 Aircraft; Aerodynamic Characteristics; In-Flight Monitoring; Leading Edge Slats; Lift; Boundary Layer Transition

19980067554

In-flight boundary-layer state measurements on a high-lift system - Main element and flap

van Dam, C. P., California, Univ., Davis, USA; Los, S. M., California, Univ., Davis; Miley, S. J., Old Dominion Univ., USA; Roback, V. E., NASA Langley Research Center, USA; Yip, L. P., NASA Langley Research Center, USA; Bertelrud, A., Analytical Services and Materials, Inc., USA; Vijgen, P. M. H. W., High Technology Corp., USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 757-763; In English
Contract(s)/Grant(s): NAS1-19858; NAS1-19864; NAS1-19299; NCC1-163; NCC1-207; Copyright; Avail: Aeroplus Dispatch

Flight experiments on NASA/Langley's B737-100 airplane were conducted to document flow characteristics for further understanding of the flow physics on multielement high-lift systems. The measurements presented in this paper show that significant regions of laminar flow exist on the main element and the foreflap of the airplane. Flow mechanisms that affect the extent of laminar flow include relaminarization of the flow in the leading-edge region of the main element and contamination of the laminar flow on the flap by turbulent shear layers emanating from upstream elements. This information should be valuable in the development and assessment of high-Reynolds-number wind-tunnel experiments and numerical models for predicting the flows around multi-element wings at full-scale high-lift conditions.
Author (AIAA)
In-Flight Monitoring; Boundary Layer Transition; Flow Characteristics; Leading Edge Flaps

19980067563

Neglect of wake roll-up in Theodorsen's theory of propellers

Ribner, Herbert S., NASA Langley Research Center, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 814-816; In English; Copyright; Avail: Aeroplus Dispatch

A critique of a paper by Shouten (1993) on the optimum propeller efficiency obtainable by neglecting profile drag, under specified operating conditions, is presented. He argues that the theory entails substantial error by failing to allow for the vortex sheet roll-up that occurs in reality. The roll-up, he claims, ensures that the static pressure in the wake tends toward ambient. The present study finds that his arguments concerning wake static pressure to be only partially correct and the conclusions concerning propeller power and efficiency untenable. It is concluded that neglect of wake roll-up only slightly mispredicts the efficiency.
AIAA
Propeller Efficiency; Rolling Moments; Theodorsen Transformation; Steady Flow; Momentum Transfer

19980067862

Studies of secondary flow at endwall of a supersonic compressor cascade

Osborne, Denver J., Jr., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Ng, Wing F., Virginia Polytechnic Inst. and State Univ., Blacksburg; Tweedt, Daniel L., NASA Lewis Research Center, USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 128-133; In English
Contract(s)/Grant(s): NAG3-830
Report No.(s): AIAA Paper 96-2558; Copyright; Avail: Aeroplus Dispatch

A combined experimental and numerical study was conducted to investigate the endwall secondary flow in a linear supersonic compressor cascade. The experiment was carried out in a supersonic wind tunnel, with Mach and Reynolds numbers (based on the blade chord) of 2.36 and 4.8 x 10 exp 6, respectively. A three-dimensional viscous computational fluid dynamics (CFD) calculation was performed to simulate the endwall boundary layer and the three-dimensional secondary flows. The experimental and computational analyses presented are all at the design incidence angle. Experimental measurements include multiple-color surface oil flow visualization applied to the endwall and blade surfaces, blade-to-blade pitot pressure contours at the 90 percent chordwise position, and upstream and downstream static pressures at the endwall. All of these measurements compare favorably with the CFD calculation. Results from the CFD analysis show that endwall total-pressure losses in this supersonic compressor cascade are a significant contributor to the overall losses and can account for one-third of the overall flowfield loss.
Author (AIAA)
Secondary Flow; Wall Flow; Supersonic Compressors; Cascade Flow

19980067866

Hybrid prismatic/tetrahedral grid generation for viscous flow applications

Sharov, Dmitri, Tohoku Univ., Japan; Nakahashi, Kazuhiro, Tohoku Univ., Japan; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 157-162; In English

Report No.(s): AIAA Paper 96-2000; Copyright; Avail: Aeroplus Dispatch

A method for the automatic generation of unstructured grids composed of tetrahedra and prisms is proposed. The prismatic semistructured grid is generated around viscous boundary surfaces and covers viscous regions, whereas the tetrahedral grid covers the rest of the computational domain. The Delaunay approach for tetrahedral grid generation is used. The proposed prismatic grid is structured in directions normal to the boundary faces, but the number of prisms generated from one boundary face is variable from face to face. Unlike conventional prismatic grid generators, this technique works well even in regions of cavities and gaps. The Delaunay background grid generated for surface nodes serves as an efficient data structure to check possible intersections of prisms. Particular attention is given to the boundary-constraining problem. A robust algorithm for the boundary recovery by edge swapping followed by a direct subdivision of tetrahedra is used. Grid examples for internal and external flow problems of complex shapes demonstrate the efficiency of the method.

Author (AIAA)

Grid Generation (Mathematics); Viscous Flow; Computational Fluid Dynamics

19980067867

Computational analysis of hypersonic turbulent flows over a projectile with aerospike

Krishnamurty, Venkata S., Florida, Univ., Gainesville, USA; Shyy, Wei, Florida, Univ., Gainesville; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 163-172; In English; Copyright; Avail: Aeroplus Dispatch

The effects of compressibility and nonequilibrium in hypersonic turbulent flows are analyzed in the k-epsilon-based modeling framework with emphasis on the influence of factors such as streamline curvature and shock discontinuities. The flow past a projectile, with and without a drag reduction spike, is investigated to assess the various modeling issues and to shed light on the merit of this interesting aerodynamic concept. The importance of an account for the compressibility and nonequilibrium effects is demonstrated. Regarding the merit of the spike/aerodisk assembly, it is observed that although the addition of the spike reduces the pressure at the nose of the projectile by a factor of 10, it only results in a marginal reduction in the temperature.

Author (AIAA)

Computational Fluid Dynamics; Hypersonic Flow; Turbulent Flow; Projectiles; Spikes (Aerodynamic Configurations)

19980067870

Application of method of characteristics to underexpanded, freejet flows with vibrational nonequilibrium

Palmer, Jennifer L., Stanford Univ., USA; Hanson, Ronald K., Stanford Univ., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 193-200; In English; Copyright; Avail: Aeroplus Dispatch

The method of characteristics (MOC) is employed computationally in the simulation of planar or axisymmetric steady supersonic flows in highly underexpanded free jets. The gas is assumed to be inviscid and nonreacting but may be vibrationally frozen, relaxing, or equilibrated. The ordinary differential equations obtained by the MOC are integrated along the characteristics by a combined second-order explicit-first-order implicit method in regions of the flow with relatively rapid vibrational energy transfer (VET) and by a fully second-order explicit method in regions with either slow or very rapid VET. Results from MOC simulations of flows with constant specific-heat ratios are verified by comparison with results obtained in previous MOC computations of expansion-fan flows and with empirically based correlations giving the size of the barrel-shock structure as a function of stagnation-to-ambient-pressure ratio. Comparisons are also made between MOC results for a vibrationally relaxing gas and results for vibrationally frozen and equilibrated gases, to verify the computational methods used to simulate flows with VET. The demonstrated capability for simulating underexpanded freejet flowfields represents a useful tool for predicting the results of experiments conducted in a small-scale shock-tunnel facility.

Author (AIAA)

Method of Characteristics; Free Flow; Supersonic Jet Flow; Nonequilibrium Flow; Vibrational Spectra

19980067872

Prediction of viscous trailing vortex structure from basic loading parameters

Rule, John A., Duke Univ., USA; Bliss, Donald B., Duke Univ., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 208-218; In English; Copyright; Avail: Aeroplus Dispatch

An analytical method has been developed to predict the structure of a fully developed trailing vortex with a viscous core. Vortex structure is calculated from the load distribution on the generating wing, and fundamental conservation laws are satisfied.

The present rollup model implicitly addresses viscous effects in the vortex core region by assuming a turbulent mixing process in the core during formation. Mixing theory suggests the appropriate functional form of the solution velocity profiles within this region, with constants that are determined uniquely by the method for arbitrary wing loading distributions. Important structural properties such as vortex strength, core size, and peak swirl velocity are calculated directly from these solution constants. The viscous core model was validated against two recent experimental studies, which provided new insight into vortex growth.
Author (AIAA)
Viscous Flow; Vortices; Blade-Vortex Interaction; Turbulent Mixing; Wing Loading

19980067886

Comment on 'Tunnel-induced gradients and their effect on drag'

Ashill, P. R., Defence Evaluation and Research Agency, UK; Taylor, C. R., Defence Evaluation and Research Agency, UK; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 298, 299; In English; Copyright; Avail: Aeroplus Dispatch

Mokry (AIAA Journal, vol. 36, no. 2, 1998) has commented on an analysis by Hackett (AIAA Journal, vol. 34, no. 12, 1996) that leads to a wake-induced drag increment that is independent of the model volume for low-speed flows in solid-wall wind tunnels. In this respect, Hackett's analysis contradicts the classical result given in Garner et al. (1966), recently also obtained by Taylor (1996) using an approach similar to that used by Mokry. The object of this Comment is to show how it is possible to recover the classical result using the form of analysis by Taylor. Taylor's analysis was performed for compressible flows, but to allow a comparison with Havkett's and Mokry's analysis, the flow is assumed to be incompressible.
AIAA
Wakes; Drag; Incompressible Flow; Wind Tunnel Tests

19980067887

Reply by the author to P. R. Ashill and C. R. Taylor

Hackett, J. E., Lockheed Martin Aeronautical Systems Co., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 299; In English; Copyright; Avail: Aeroplus Dispatch

This paper is a reply by Hackett to Ashill's and Taylor's (AIAA Journal, vol 36, no. 2, 1998) comment on a paper by Hackett (AIAA Journal, vol. 34, no. 12, 1996) concerning wind tunnel-induced gradients and their effect on drag. This Reply paper tackles the issue of the base pressure term in the momentum equation, the importance of which was recognized in Ashill and Taylor's Comment.
AIAA
Wakes; Displacement; Air Flow; Drag

19980067888

Comment on 'Tunnel-induced gradients and their effect on drag'

Cooper, Kevin R., National Research Council of Canada, Ottawa, Canada; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 299, 300; In English; Copyright; Avail: Aeroplus Dispatch

This Comment points out a typographical error and a limitation in the equations for the two-step method proposed by Hackett (AIAA Journal, vol. 34, no. 12, 1996) for the blockage correction of separated flows in a closed-wall wind tunnel. At the same time, this Comment also offers some experimental verification of the correct analysis that was developed by Hackett (1994).
AIAA
Drag; Separated Flow; Wind Tunnel Walls

19980067889

Reply by the author to K. R. Cooper

Hackett, J. E., Lockheed Martin Aeronautical Systems Co., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 300, 301; In English; Copyright; Avail: Aeroplus Dispatch

This Reply paper by the author to a Comment paper by Cooper (AIAA Journal, vol. 36, no. 2, 1998) on the author's papers on wind tunnel-induced gradients and their effect on drag (Hackett, AIAA Journal, vol. 34, no. 12, 1996; 1994). The Reply thanks Cooper for pointing out the typographical error in Eq. (14) of the AIAA Journal paper (Hackett, 1996) and the fact that the applicability of the equation is limited. This Reply points out two significant changes that Cooper's equations expose which occurred during the preparation of the conference version of the paper by Hackett. The first is the use of the full quadratic solution for Delta-C(DM1). The second is the introduction of Delta-C(DM1) in the denominator of Cooper's Eq. (5). Both were included in the original work by Hackett (1994), from which the conference and the AIAA Journal figures were taken. This Reply points out that

Cooper makes a good point that the revised approach removes the tendency of the original Maskell form to overcorrect all forces and moments, not just drag.
AIAA
Drag; Linearization

19980067890

Comment on 'Tunnel-induced gradients and their effect on drag'

Mokry, M., National Research Council of Canada, Ottawa, Canada; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2; In English; Copyright; Avail: Aeroplus Dispatch

This paper is a comment on a paper by Hackett (AIAA Journal, vol. 36, no. 12, 1996) concerning wind tunnel-induced gradients and their effect on drag, which discusses a wake-induced drag increment that is independent of the buoyancy drag, gradient times volume, form regularly used to correct wind tunnel data (Garner et al., 1966). This Comment states that the obtained result is essentially correct, but because it is derived from kinematic concepts using local velocity gradients, it may lead to an erroneous interpretation that the buoyancy drag has already been accounted for in the procedure. It is then illustrated that Hackett's result can be identified more rigorously if derived instead from the balance of streamwise momentum.
AIAA
Drag; Wakes; Wind Tunnel Tests

19980067891

Reply by the author to M. Mokry

Hackett, J. E., Lockheed Martin Aeronautical Systems Co., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 302; In English; Copyright; Avail: Aeroplus Dispatch

This brief note is a reply by Hackett to Mokry's Comment paper (AIAA Journal, vol. 36, no. 2, 1998) on Hackett's paper (AIAA Journal, vol. 34, no. 12, 1996) concerning wind tunnel-induced gradients and their effect on drag. This Reply states that the assumption in Mokry's analysis of stagnant flow within the model/wake body retains the essential features yet avoids treating the source singularity and its added mass flow. However, Mokry's assertion that the residual drag of Eq. (6) does not include drag due to gradient effects at the model is the subject of this Reply. Another point brought up here concerns Mokry's assumption, following Eq. (4), that the wake area is small compared with the tunnel area. The author shows that this assumption is unnecessary by citing the analysis given by Prandtl and Tietjens (1957). In view of this, it remains the author's view that the result expressed by Mokry as Eq. (6) does include gradient effects at the model, and it is not limited to small wakes.
AIAA
Drag; Wind Tunnel Walls

19980067893

Flutter investigations in a finite, straight, 2D wind tunnel compressor cascade in incompressible flow ***Windkanal-Flatter-untersuchungen an einem endlichen, geraden 2d-Verdichtergitter in inkompressibler Stroemung***

Hennings, Holger, DLR, Inst. fuer Aeroelastik, Germany; 1997; In German
Report No.(s): DLR-FB-97-20@ISSN 0939-2963; Copyright; Avail: Aeroplus Dispatch

Flutter investigations carried out in the wind tunnel on an even and linear 2D compressor cascade are described. The cascade blades are suspended in elastic elements. The cascade is excited in the subcritical region by means of a mechanically actuated blade. The frequency response functions are decomposed into eigenvibrations. A spectral analysis of the self-excited oscillations is made at flutter velocity. These results permit the flutter mechanism to be described. For purposes of comparison, flutter calculations are carried out for a 2D ring cascade and for a finite linear cascade.
Author (AIAA)
Aeroelasticity; Flutter; Cascade Flow; Compressor Blades; Wind Tunnel Tests; Incompressible Flow

19980068001

Effect of surface mass transfer on flow around blunt cones during hypersonic flight ***Vliyanie poverkhnostnogo massoobmena na obtekanie zatuplennykh konusob pri polete s giperzvukovymi skorostyami***

Zakharchenko, V. F., Russia; Seriya Mashinostroenie; Jun. 1997; ISSN 0236-3941, no. 2, pp. 14-25; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of experimental and analytical/theoretical studies of hypersonic flow around blunt bodies are presented with allowance for the effect of the aerodynamic characteristics of surface mass transfer associated with thermal shield ablation or with the operation of active thermal protection systems based on coolant injection through porous surfaces. The efficiency of numerical

methods for calculating supersonic flow in the presence of intensive surface mass transfer and with allowance for friction parameters and heat transfer beyond the region of intensive coolant injection is demonstrated.
AIAA
Blunt Bodies; Mass Transfer; Conical Bodies; Aerodynamic Heat Transfer; Hypersonic Flow; Aerodynamic Characteristics

19980068045

Wingtip vortices and exhaust jets during the jet regime of aircraft wakes

Gerz, T., DLR, Germany; Ehret, T., Karlsruhe, Univ., Germany; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 7, pp. 463-474; In English; Copyright; Avail: Aeroplus Dispatch

By means of a vortex-filament technique and large-eddy simulations, the dynamics during the jet regime of the wake of a subsonic aircraft cruising in a stably stratified and turbulent atmosphere is simulated. Such issues as the roll-up process of the vortex sheet around the wings into the wingtip vortices, the effect of the vortices upon the deformation and displacement of the exhaust jets, and the resulting distribution of the exhaust, are addressed. It is found that the roll-up process already significantly displaces the exhaust jets. The evolving wingtip vortices attract the exhaust and collect it around the vortex cores. This entrainment is further controlled by the buoyancy force of the hot exhaust, whereas the body of the aircraft, as a source of circulation disturbance, has no significant influence. Histories of temperature and species concentration can be used to determine the duration of the jet regime which, for a cruising B-747 aircraft lasts for 20 +/-2 s. During that time the temperature of the trapped exhaust decays to the ambient value, and then rises again. Likewise, the exhaust concentration drops to 0.03 percent of its initial value but then stays constant during the vortex regime. Throughout the jet regime, the species are inhomogeneously mixed around the vortex cores with half-moon shaped local maxima.
Author (AIAA)
Wing Tip Vortices; Jet Exhaust; Aircraft Wakes; Large Eddy Simulation; Subsonic Aircraft; Cruising Flight; Atmospheric Turbulence

19980068046

Aerodynamic aspects of engine-aircraft integration of transport aircraft

Hoheisel, H., DLR, Inst. fuer Entwurfsaerodynamik, Germany; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 7, pp. 475-487; In English; Copyright; Avail: Aeroplus Dispatch

This contribution highlights different aspects of engine-airframe integration and summarizes areas of concern for engine installation, such as engine development trends, turbofan integration with respect to advanced engine concepts, programs and investigations on propeller integration, application of theoretical methods (in particular with respect to viscous effects), engine location, nacelle design, and flow aspects as well as jet flows.
Author (AIAA)
Engine Airframe Integration; Transport Aircraft; Aerodynamic Characteristics; Aircraft Engines; Computational Fluid Dynamics

19980068054

A note on the potential contribution of wing-body interference drag to the total drag of an aircraft

Bernstein, L., Queen Mary and Westfield College, UK; Aeronautical Journal; Nov. 1997; ISSN 0001-9240; Volume 101,, no. 1009, pp. 417-420; In English; Copyright; Avail: Aeroplus Dispatch

The implications of a rise in the pressure drag of a wing near its junction with a fuselage are examined. Based on some data measured for a swept-wing-plate junction in which the wing had a NACA 0015-profile normal to its leading edge and swept back at 20 deg, it is found that there is a potential penalty of order 1 percent of the total aircraft drag in the cruise condition.
Author (AIAA)
Aerodynamic Interference; Body-Wing Configurations; Aerodynamic Drag; Pressure Drag

19980068056

Efficient lift enhancement of a blunt edged delta wing

Traub, L. W., Texas A & M Univ., College Station, USA; Aeronautical Journal; Nov. 1997; ISSN 0001-9240; Volume 101,, no. 1009, pp. 439-445; In English; Copyright; Avail: Aeroplus Dispatch

A wind tunnel study was undertaken to determine the effectiveness of leading edge vortex plates in enhancing the lifting abilities of a blunt-edged delta wing. In the investigation, vortex plates were attached to both the upper and lower surfaces of the leading edge. Various positions of the vortex plates with respect to the wing's leading edge were evaluated. The results indicate that a vortex plate located on the upper surface of the wing is capable of increasing lift so as to be comparable to a similar sharp edged

wing, while reducing drag through some retained leading edge thrust. The increase in zero lift drag associated with vortex plate attachment tends to limit potential performance improvements. A vortex plate mounted on the lower wing surface decreased lift slightly compared to the blunt wing. However, drag was found to decrease markedly.
Author (AIAA)
Delta Wings; Blunt Leading Edges; Lift

19980068280

Role of vibrational-dissociative interaction in hypersonic flow ***Rol' kolebatel'no-dissotsiatsionnogo vzaimodejstviya pri giperzvukovom obtekanii***

Egorov, I. V., Russia; Nikol'skij, V. S.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Jun. 1997; ISSN 0568-5281, no. 3, pp. 150-163; In Russian; Copyright; Avail: Aeroplus Dispatch

The problem of vibrational-dissociative interaction in hypersonic flow around a sphere is investigated over a certain range of the governing parameters. The analysis is based on the numerical solution of full Navier-Stokes equations using thermally equilibrium and nonequilibrium models of air with allowance for nonequilibrium chemical reactions for different catalytic properties of the body surface. The role of thermochemical nonequilibrium in the formation of the flow field structure in hypersonic flow around the windward section of a blunt body is discussed.
AIAA
Hypersonic Flow; Gas Dissociation; Thermodynamic Equilibrium; Blunt Bodies; Aerodynamic Heating; Molecular Oscillations

19980068282

Evolution of longitudinal vortices in the initial section of a supersonic nonisobaric jet in the presence of microinhomogeneities of the internal nozzle surface ***Razvitie prodol'nykh vikhrej v nachal'nom uchastke sverkhzvukovoj neizobaricheskoj strui pri nalichii mikronerovnostej vnutrennej poverkhnosti sopla***

Zapryagaev, V. I., Russia; Solotchin, A. V.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Jun. 1997; ISSN 0568-5281, no. 3, pp. 180-185; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of an experimental study of the effect of localized microinhomogeneities of the internal nozzle surface on the formation and evolution of azimuthal inhomogneities at the boundary of a supersonic underexpanded jet are presented. Data are presented on the effect of inhomogeneities, whose size is comparable with the displacement thickness of the boundary layer at the nozzle exit section, on the spectral composition of the wavenumbers of azimuthal inhomogeneities. The longitudinal coordinate dependence of the amplitude of the spectral components, whose changes correlate with the gasdynamic structure of the initial section of the nonisobaric jet, is determined for the natural and artificial nozzle roughness.
AIAA
Vortices; Supersonic Jet Flow; Surface Roughness Effects; Nozzle Flow; Flow Geometry

19980068288

Optimal flows are subject to simulation ***Optimal Stroemungen sind berechenbar***

DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 34-39; In German; Copyright; Avail: Aeroplus Dispatch

Optimal flow studies being carried out at the Institut fuer Entwurfsaerodynamik (the Institute for Aerodynamic Design) in Germany are discussed. Attention is given to the MEGAFLOW computerized flow simulation, the development of efficient and environmentally friendly propulsion concepts, noise reduction, and space transportation vehicles for the International Space Station.
AIAA
Computational Fluid Dynamics; Computerized Simulation; Optimization; International Space Station; Noise Reduction; Spacecraft Propulsion

19980068629

Effect of wall suction on leading edge contamination

Arnal, D., ONERA, France; Juillen, J. C., ONERA, France; Reneaux, J., ONERA, France; Gasparian, G., ONERA, France; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 8, pp. 505-517; In English; Copyright; Avail: Aeroplus Dispatch

This paper is devoted to an experimental study of swept wing leading edge contamination by the turbulence emanating from the wing-wall junction. The main objective is to delay the contamination onset by applying surface suction along the attachment line. Two series of experiments are described: the first one was performed in a small wind tunnel at CERT ONERA, the second one was carried out in the F2 wind tunnel at Le Fauga Mauzac center. Hot film measurements showed that leading edge contamina-

tion could be delayed up to very large Reynolds numbers. We also studied the behavior of the relaminarized boundary layer downstream of the suction region, along the span as well as in the chordwise direction.
Author (AIAA)
Suction; Leading Edges; Boundary Layer Transition; Swept Wings; Turbulence Effects; Wind Tunnel Tests

19980068635

The low-speed aerodynamics of helicopters - The phenomena that are involved and ongoing research ***L'aerodynamique des basses vitesses des helicopteres - Phenomenes en jeu et recherches en cours***

Philippe, J. J., ONERA, France; ONERA, TP no. 1997-42; 1997; In French
Report No.(s): ONERA, TP no. 1997-42; Copyright; Avail: Aeroplus Dispatch

The helicopter is essentially a low-speed aircraft. The subject of this paper is limited to the low-speed aerodynamic aspects of helicopters. Examined are the aerodynamics of helicopter fuselages, the aerodynamics of the rotors, and the aerodynamics of the whole aircraft, emphasizing the physical phenomena involved and their consequences. Then, a succinct description is presented of the research in progress to understand, predict, and control these phenomena. Singularity codes and boundary layer codes, and their coupling, are discussed as calculation methods for helicopter fuselages. Actual work that is taking place at ONERA concerning the aerodynamics of helicopter fuselages is cited. The low-speed aerodynamics of helicopter rotors is discussed, outlining the basic physical phenomena and the calculation methods, which, it is concluded, require the coupling of CFD codes and rotor dynamics codes. The basic physical phenomena and the calculation codes for the whole helicopter are addressed. ONERA and DLR will be cooperating in developing Euler and Navier-Stokes CFD codes for the whole helicopter in response to the needs of the Eurocopter program.
AIAA
Low Speed; Helicopters; Aerodynamic Characteristics; Rotary Wings

19980068667

Vortex shedding behind a bluff body in a slowly varying pipe flow

Hu, C. C., Cheng Kung Univ., Taiwan, Province of China; Miau, J. J., Cheng Kung Univ., Taiwan, Province of China; Chou, J. H., Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 33-37; In English; Copyright; Avail: Aeroplus Dispatch

The vortex shedding behavior of a T-shape cylinder subject to the condition of periodically unsteady pipe flow was examined experimentally. As the pipe flow velocity varied at low frequency, the instantaneous shedding frequency measured varied with time in accordance with the instantaneous velocity. When the pipe flow velocity was increased, the shedding frequency was increased accordingly and vice versa. The phenomenon of lag and lead in the vortex shedding frequency was noted as the pipe flow in acceleration and deceleration, respectively. Further analysis of the integration of the vorticity shed from a bluff body within one period of vortex shedding in unsteady pipe flow reveals that the behavior of vorticity convection during one shedding period in the case of unsteady pipe flow is similar to that of steady pipe flow.
Author (AIAA)
Vortex Shedding; Bluff Bodies; Pipe Flow; Unsteady Flow; Flow Velocity; Cylinders

19980068668

Pressure fluctuation of transonic turbulent boundary layer past convex corners

Chung, Kung-Ming, Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 38-42; In English; Copyright; Avail: Aeroplus Dispatch

Experiments were performed in the ASTRC/NCKU transonic wind tunnel at Mach 0.825. The Reynolds number was 22.6 million per meter. The turbulent boundary layer developed along the flat plate installed in the test section. Convex corners of 5, 10, and 15 deg were located at 0.50 m from the leading edge of the plate. The test surface was instrumented for surface pressure measurements using flush-mounted, fast-response pressure transducers. The mean surface pressure distributions shows strong favorable pressure gradient ahead of convex corners, which indicates strong inviscid-viscous interactions. The viscous effects affect the effective body shape. The adverse pressure gradient downstream of convex corners has strong effects on the unsteadiness of the flow. The microscales of the pressure eddies grow with the convex-corner angles. For alpha = 15 deg, the boundary layer is separated. The probability density function is highly skewed. Strong intensity of the pressure fluctuation is obtained, whose spectrum is centered at about 780 Hz. It is also observed that the low-frequency components of the spectra increase with the convex-corner angle, which indicates the amplification of low-frequency, high-amplitude scales.
Author (AIAA)
Pressure Oscillations; Transonic Flow; Boundary Layer Flow; Turbulent Boundary Layer; Corner Flow; Transonic Wind Tunnels

19980068669

Streamwise vortex production by an array of inclined jets

Zhang, X., Southampton, Univ., UK; Collins, M. W., City Univ., UK; 1997, pp. 43-49; In English; Copyright; Avail: Aeroplus Dispatch

The nearfield evolution of streamwise vortices embedded in a turbulent boundary layer was examined in a wind-tunnel test. Co-rotating vortices were produced by an array of inclined round jets, the diameter of the jet being 14 mm. Flow properties were measured at a freestream velocity of 20 m/s using a laser Doppler anemometer. The control parameter is the jet velocity ratio. It was observed that streamwise vortices are produced through interaction between inclined jets and the turbulent boundary layer. A single vortex follows each inclined jet. Significant differences exist between the vortices generated at a jet velocity ratio of less than unity and those above unity, with deeply embedded vortices being observed at lower jet velocity ratios. The study provided some insight into the flow physics and a database.

Author (AIAA)

Vortices; Near Fields; Turbulent Boundary Layer; Wind Tunnel Tests; Jet Flow; Laser Doppler Velocimeters

19980068671

An experimental investigation of aerodynamic characteristics on an airfoil in Indonesia low speed tunnel

Sawai, Napoleon, Agency for the Assessment and Application of Technology, Indonesia; Budianta, Winarwan A., Nusantara Aircraft Industry, Indonesia; 1997, pp. 54-60; In English; Copyright; Avail: Aeroplus Dispatch

A measurement technique to investigate a certain airfoil has been developed in the Indonesian Low Speed Tunnel (ILST) using basic methods and various approaches. An analysis has been conducted to improve the measurement technique and the test results as well. The effects of the tunnel parameters have been studied and analyzed to provide reliable data and to initialize more studies of tunnel applications. This paper describes a general method that has been used recently in the ILST to conduct a 2D test. Analysis performed on the 2D test results indicate that the experimental data closely resemble theoretical prediction, thus satisfying the specifications defined by the Nusantara Aircraft Industry (IPTN) as the customer of this experiment.

Author (AIAA)

Aerodynamic Characteristics; Airfoils; Low Speed Wind Tunnels; Indonesian Space Program

19980068673

Visualization study of a high-alpha airfoil under periodic flapping excitation

Hsiao, F. B., Cheng Kung Univ., Taiwan, Province of China; Liang, P. F., Cheng Kung Univ., Taiwan, Province of China; Leoviriyakit, K., Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 69-76; In English; Copyright; Avail: Aeroplus Dispatch

This experimental study visualizes the flow field around a 2D NACA 633-018 airfoil under leading-edge oscillating-flap excitation in a towing tank at a Reynolds number of 40,000. Both photocameras and video cameras are used to record the flow patterns using laser sheet lighting. The photographs depict the detailed dynamic motion of the shedding vortices and the deep stall phenomenon, indicating that the oscillating-flap excitation technique used here clearly influences the trajectory of the shedding-vortex motion and its convection speed, as well as enhances the vortex strength, which results in improved aerodynamic performance of a stalled airfoil.

Author (AIAA)

Flow Visualization; Airfoil Profiles; Aerodynamic Stalling; Leading Edges; Excitation; Separated Flow

19980068680

The technique research on 2-D flexible wall adaptive wind tunnel for 3-D flows at higher angle of attack

Jiao, Yuqin, Northwestern Polytechnical Univ., China; Zuo, Peichu, Northwestern Polytechnical Univ., China; He, Jiaju, Northwestern Polytechnical Univ., China; 1997, pp. 127-134; In English; Copyright; Avail: Aeroplus Dispatch

Research is reported on a 2D flexible wall adaptive wind tunnel for 3D model tests at high angles of attack. A 3D image method is proposed to calculate wall interference and 2D wall adaptation to minimize wall interference in 3D flow. It is shown by verification that it is feasible to carry out 3D model tests at higher angles of attack in 2D adaptive wall wind tunnels.

Author (AIAA)

Research and Development; Wall Flow; Wind Tunnel Tests; Three Dimensional Flow; Angle of Attack; Wind Tunnel Models

19980068682

Several ways to control the flow separation at the root part of forward-swept wing (FSW)

Zhang, Binqian, Northwestern Polytechnical Univ., China; Laschka, B., Munich, Technical Univ., Germany; 1997, pp. 140-143; In English; Copyright; Avail: Aeroplus Dispatch

The effects of canards, inboard fairings, movable strakes, fixed strakes, hinged strakes, and strake flaps on controlling the flow separation at the root part of FSWs are investigated by wind tunnel and water tunnel tests. The mechanism of these control methods and their effects on aerodynamic characteristics are discussed. These methods noticeably improve the flow inboard near the wing root of FSWs and raise the lift-drag characteristics and the stall behavior.
Author (AIAA)
Separated Flow; Swept Wings; Strakes; Aerodynamic Characteristics

19980068684
The development of finite element method in computational finite element method application in spacecraft configuration
Jiang, G. Q., Beijing Inst. of Aerodynamics, China; Wang, Y., Beijing Inst. of Aerodynamics, China; Mao, G. L., Beijing Inst. of Aerodynamics, China; 1997, pp. 150-157; In English; Copyright; Avail: Aeroplus Dispatch

A recent development of the FEM in computational aerothermodynamics and its application to spacecraft configurations is described. Computational results on the flow field characteristics and heat flux contribution to the surfaces of spacecraft configurations are presented. The application examples include the flow field and heat flux of a whole spacecraft shape and the flow and heat flux characteristics in the vicinity of an attitude control engine. The results show reasonably good agreement with experiments.
Author (AIAA)
Finite Element Method; Spacecraft Configurations

19980068687
Grid generation techniques for complex aerodynamic configurations
Li, Jie, Northwestern Polytechnical Univ., China; Li, Fengwei, Northwestern Polytechnical Univ., China; E, Qin, Northwestern Polytechnical Univ., China; Chen, Haixin, Northwestern Polytechnical Univ., China; 1997, pp. 171-175; In English; Copyright; Avail: Aeroplus Dispatch

A procedure for the generation of 2D and quasi-3D grids with control of orthogonality and spacing with respect to body surface is described. The elliptic grid generation equations are solved by means of two different algorithms. Examples of grids for various realistic configurations are given that highlight the characteristics and behavior of the methods.
Author (AIAA)
Grid Generation (Mathematics); Aerodynamic Configurations; Orthogonality

19980068688
A study of a transonic wing for laminar and turbulent flow
Chung, K., Cheng Kung Univ., Taiwan, Province of China; Chang, K., Cheng Kung Univ., Taiwan, Province of China; Miau, J., Cheng Kung Univ., Taiwan, Province of China; Chou, J., Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 176-181; In English; Copyright; Avail: Aeroplus Dispatch

An experimental study is performed on the aerodynamic characteristics of a finite transonic wing. A basic swept and a combined wing are employed at the testing Mach number of 0.75, 0.80, and 0.85 with pitch angle of 0-4 deg. In addition, experiments are conducted at the ASTRC/NCKU 600 mm square transonic wind tunnel. The Reynolds number based on the mean chord of the wing is about 1.53 million. For the free transition case, laminar separation occurs on the suction surface of the wing. The development of separation bubble or mass flow separation is visible from the surface oil flow visualization, and no trailing edge separation is observed in this case. At the same freestream Mach number, the positions of shock wave move upstream and the local flow separation region is enlarged. For the wingtip vortex measurements, the streamwise velocity distribution for the basic wing shows a velocity overshoot in the outer region of the wingtip vortex while a velocity deficit exists in the inner region. Further, the study of the combined wing indicates a strong effect of winglets on the structure of the wingtip vortex. The vortex diffuses and moves outward while the vortex strength is reduced.
Author (AIAA)
Transonic Flow; Swept Wings; Laminar Flow; Turbulent Flow; Aerodynamic Characteristics; Transonic Wind Tunnels

19980068689
High speed flow design using osculating axisymmetric flows
Sobieczky, H., DLR, Germany; Zores, B., DLR, Germany; Wang, Z., Beijing Univ. of Aeronautics and Astronautics, China; Qian, Y. J., Beijing Univ. of Aeronautics and Astronautics, China; 1997, pp. 182-187; In English; Copyright; Avail: Aeroplus Dispatch

The introduction of an inverse method of characteristics in the osculating cones design concept for supersonic flow components extends the options for generating aerospace configurations with supersonic leading edges and inlet diffusors. The concept

of osculating axisymmetric flows yields rotational flow domains from input curved shocks, leading to more practical waverider shapes with higher volumetric efficiency.
Author (AIAA)
Flow Velocity; Supersonic Flow; Axisymmetric Flow; Method of Characteristics; Waveriders; Rotating Fluids

19980068690
The numerical prediction of vortex flow and vortex breakdown over a delta wing at high angles of attack
Jia, Jianbo, Harbin Inst. of Aerodynamics, China; Cui, Xiuyan, Harbin Inst. of Aerodynamics, China; 1997, pp. 188-194; In English; Copyright; Avail: Aeroplus Dispatch

An algorithm for the solution of the incompressible Euler and Navier-Stokes equations in 3D generalized curvilinear coordinates is presented. The pressure field solution is based on the pseudocompressibility approach in which the time derivative pressure term is introduced into the mass conservation equation to form a set of hyperbolic equations. The solution procedure employs an implicit, approximate factorization scheme. Results are presented for the numerical simulation of the incompressible flow about a 60 and 70 deg sharp-edged delta wing employing an Euler method as well as a Navier-Stokes method. The Euler and N-S solutions for the configuration are compared with experimental results available. The viscous flow computations have been performed at a Reynolds number of 0.828 million, identical to the one of the experiment, employing the Baldwin-Lomax turbulence model. The computed results indicate that the Euler method can capture the vortical flow feature. The Navier-Stokes results show a much improved correlation with the experimental data in addition to the flow features already captured by the Euler method, specifically a leading-edge separated vortex, secondary separation induced by the leading-edge vortex, and vortex breakdown.
Author (AIAA)
Prediction Analysis Techniques; Vortices; Vortex Breakdown; Delta Wings; Angle of Attack; Computational Fluid Dynamics

19980068692
Control of shock induced separation by surface suction
Zhu, Y., Cranfield Univ., UK; Qin, N., Cranfield Univ., UK; 1997, pp. 204-211; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a numerical study of the effects of an active surface suction on shock/boundary layer interactions over transonic aerofoils. Two candidates were studied. A NACA64A010 aerofoil with a trailing edge flap was investigated due to the existence of experimental data for the validation of the numerical method. Thereafter an RAE9647 aerofoil, which was designed for superior aerodynamic performance for a helicopter rotor blade, was studied with an active surface suction installed to prevent or alleviate the shock reduced separation. The suction strength and location were studied to provide an effective control of the undesirable flow features.
Author (AIAA)
Suction; Transonic Flow; Airfoil Profiles; Aircraft Design

19980068693
Viscous-inviscid analysis of transonic flow about wings
Zhong, Chengwen, Northwestern Polytechnical Univ., China; Su, Yaoxi, Northwestern Polytechnical Univ., China; 1997, pp. 212-215; In English; Copyright; Avail: Aeroplus Dispatch

A method of semi-inverse viscous-inviscid interaction for the computation of transonic separated viscous flow on wing is presented. The method consists of the computation of transonic inviscid flow, the computation of boundary layer of mixed type, and the interaction. The inviscid flow is described by full potential equation. 3D boundary layer flow is simulated by an integral method, including the computation of the laminar boundary layer, the turbulent boundary layer, and a 3D transition region. The computation of the 3D boundary layer is switched to inversed mode when the flow is close to separation. Convergent solutions of transonic flow around a M6 wing are obtained. The results of the pressure distribution and boundary layer development of the wing at four spanwise stations are given and compared with experimental results. The agreement is satisfactory. It is shown that the method can compute 3D transonic viscous flow with shock-induced separation bubbles and trailing edge separation of limited extent.
Author (AIAA)
Viscous Flow; Inviscid Flow; Transonic Flow; Separated Flow; Wing Profiles; Turbulent Boundary Layer

19980068694
Numerical computation of buffet boundaries for wings
Zhong, Chengwen, Northwestern Polytechnical Univ., China; Su, Yaoxi, Northwestern Polytechnical Univ., China; 1997, pp. 216-218; In English; Copyright; Avail: Aeroplus Dispatch

An improved method for the computation of buffet boundaries for wings is presented. The viscous-inviscid interaction method is used to compute the 3D viscous separated transonic flow in the present method. Then, according to the style of the separated flow and the size of the separated flow region, combined with the Thomas criterion, it is estimated whether the wing is buffeted. The present method has two main characteristics, one being the semiinversed interaction method used to avoid the singularity of boundary layer integral equations. Thus the method can compute 3D transonic viscous flow with shock-reduced separation bubbles and trailing edge separation of limited extent. The other method of complete mixed boundary layer computation, namely, the instability and transition of the laminar boundary layer, is carefully considered. The 3D transition boundary can be calculated. As the result, the present method can more exactly predict the separation and its development. Sequentially, the estimated buffet boundary is more satisfactory. As an example, the buffet boundary of F-86A airplane is calculated. Compared with the measured results in flight tests, the agreement is satisfactory.
Author (AIAA)
Buffeting; Viscous Flow; Inviscid Flow; Wing Profiles; Transonic Flow; Fighter Aircraft

19980068697

Numerical analysis of multiple element high lift devices by Navier-Stokes equations

Ai, Xing, Northwestern Polytechnical Univ., China; Su, Yaoxi, Northwestern Polytechnical Univ., China; 1997, pp. 235-238; In English; Copyright; Avail: Aeroplus Dispatch

This paper deals with the numerical computation of viscous flows around multiple-element high-lift devices by solving the time-dependent, Reynolds-averaged Navier-Stokes equations using a grid patching scheme in conjunction with an Alternating Direction Implicit (ADI) finite difference method. In order to calculate the low Mach number flows, preconditioning method is applied to accelerate the convergence to a steady state. An algebraic turbulence model is used to predict turbulence characteristics of the flows. The patched grids are generated using the partial differential method combined with 2D panel method. Numerical calculations are carried out for the single slotted flap configuration.
Author (AIAA)
Lift; Navier-Stokes Equation; Viscous Flow; Alternating Direction Implicit Methods; Finite Difference Theory; Computational Fluid Dynamics

19980068698

Grid generation around multiple element airfoils

Ai, Xing, Northwestern Polytechnical Univ., China; Su, Yaoxi, Northwestern Polytechnical Univ., China; 1997, pp. 239-242; In English; Copyright; Avail: Aeroplus Dispatch

This paper develops a method to generate a orthogonal body-fitted regional grid system around a general multiconnected 2D region containing any number of airfoils automatically. The solution of potential flows around airfoils solved by a 2D panel method is used as a building block of the automated grid generator. The dividing streamlines containing body surfaces are traced numerically and fixed as the regional interfaces. The computational grids are generated on each block respectively by solving the partial differential equations. It is shown that the generated grids are orthogonal and continuous across all the region including the regional interfaces.
Author (AIAA)
Grid Generation (Mathematics); Airfoil Profiles; Computational Fluid Dynamics

19980068730

Prediction of aerodynamic characteristics of the helicopter rotor with anhedral tip shape

Xu, Guohua, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Shicun, Nanjing Univ. of Aeronautics and Astronautics, China; 1997, pp. 421-428; In English; Copyright; Avail: Aeroplus Dispatch

A new analytical approach, based on a lifting surface model and a full-span free-wake analysis using the curved vortex element on a circular arc, is established for evaluating the aerodynamic characteristics of a rotor with an anhedral blade tip. It is shown to be applicable to various blade-tip configurations, including combined tapered, swept, and anhedral tip shapes. Sample calculations on different anhedral tips for both hover and forward flight are performed. The results of the induced velocity and blade section lift distribution, tip vortex path, and rotor performance are presented so that the effect of the anhedral tip on rotor aerodynamic characteristics is fully analyzed.
Author (AIAA)
Prediction Analysis Techniques; Aerodynamic Characteristics; Rotary Wings; Wing Tips

19980068740

Application of TVD scheme in modeling the flow of base bleed projectiles

Yang, Yuwang, Nanjing Univ. of Science and Technology, China; Zheng, Ya., Nanjing Univ. of Science and Technology, China; Wu, Xiaosong, Nanjing Univ. of Science and Technology, China; Chen, Jun, Nanjing Univ. of Science and Technology, China; Qiu, Gangsheng, Nanjing Univ. of Science and Technology, China; 1997, pp. 475-480; In English; Copyright; Avail: Aeroplus Dispatch

A kind of implicit finite volume TVD scheme of the full unsteady Euler equations of gas dynamics is used in this paper to model the projectile base flow with and without base bleed. This numerical method has the obvious advantages of high shock resolution and accuracy as well as a finite volume scheme suitable for complex flow. The speed vector distribution and shock profiles are obtained from the computation. The numerical results show the characteristics of base bleed flow such as the flow parameter distribution. The results agree well with experimental data.

Author (AIAA)

TVD Schemes; Projectiles; Digital Simulation; Inviscid Flow; Unsteady Flow

19980069437

Numerical simulations of commercial aircraft wakes subjected to airport surface weather conditions

Ash, Robert L., Old Dominion Univ., USA; Zheng, Z. C., South Alabama, Univ., USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 18-26; In English

Contract(s)/Grant(s): NAG1-1437

Report No.(s): AIAA Paper 96-0660; Copyright; Avail: Aeroplus Dispatch

Using tower flyby data for validation, we have developed a 2-D numerical simulation of the influence of surface weather conditions on wake vortex motion and decay for representative commercial aircraft. Our simulations support the conjecture that the ratio of eddy viscosity to kinematic viscosity, appropriate for modeling aircraft wakes, scales linearly with circulation, which yields a nominally constant equivalent Reynolds number for all commercial aircraft sizes. We have tested the constant eddy viscosity approximation for three different aircraft types and six surface weather states, showing the utility of the approach in predicting wake vortex motion and decay. We have also shown how data from one aircraft flight test can be used to infer the decay behavior of another, and we have examined the influence of the six surface weather states on the vortex decay behavior predicted for a large commercial aircraft. Based upon these simulations, we have determined that the 2-D, constant eddy viscosity approach can be useful in assessing the influence of surface weather conditions on wake vortex decay.

Author (AIAA)

Commercial Aircraft; Aircraft Wakes; Airports; Aviation Meteorology; Vortices

19980069438

Simple numerical method to compute viscous lift loss of wings

Crabbe, R. S., National Research Council of Canada, Ottawa, Canada; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 27-32; In English; Copyright; Avail: Aeroplus Dispatch

It is well known that the lift of a wing is less than the value computed on the basis of potential flow because of the presence of a boundary layer on the surface. A method of computing this lift loss is described based on numerically solving the integral equations of the three-dimensional boundary-layer flow in a streamline coordinate system. When applied to several swept, tapered, and twisted wings, the method closely predicts the lift curve measured in a wind tunnel. Similar computations with a 2-D (strip) model overestimate wing viscous lift loss by about 10 percent. The numerical effort required to solve the integral boundary-layer equation set is much less than that required to solve either the 3-D boundary-layer equations or the Navier-Stokes equations, with little loss in accuracy. It could easily be used, therefore, for preliminary estimates of climb and cruise wing performance. A simple procedure is presented for identifying crossflow separation.

Author (AIAA)

Computational Fluid Dynamics; Viscous Flow; Lift; Three Dimensional Boundary Layer

19980069440

Computational study of transonic equivalence rule with lift

Luo, Shijun, Northwestern Polytechnical Univ., China; Wang, Lixia, GE Research and Development Center, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 39-45; In English; Copyright; Avail: Aeroplus Dispatch

The transonic equivalence rule with lift is studied computationally using the full-potential code. Two pairs of equivalent wings are designed according to the assumptions of the equivalence rule at freestream Mach number = 0.94. One pair of equivalent wings has a concorde-like planform and the other pair has a delta planform with sine tip-fairing. The computed pressure distribu-

tions in the outer flowfield of the two pairs of equivalent wings and the wave drag coefficients of the former pair are analyzed, and the equivalence rule is verified.
Author (AIAA)
Transonic Flight; Lift; Equivalence; Wing Planforms

19980069441
Pitch rate and Reynolds number effects on unsteady boundary-layer transition and separation
Schreck, Scott J., USAF, USA; Faller, William E., Johns Hopkins Univ., USA; Helin, Hank E., USAF, Operational Test and Evaluation Center, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 46-52; In English
Report No.(s): AIAA Paper 94-2256; Copyright; Avail: Aeroplus Dispatch

A NACA 0015 airfoil was pitched at a constant rate through static stall to elevated angles of attack. Shear stress measurements of high spatial and temporal resolution were performed near the airfoil leading edge, in the vicinity of subsequent dynamic stall vortex initiation. Using these data, unsteady boundary layer reversal and transition were characterized for a range of nondimensional pitch rates and Reynolds numbers. Analyses revealed the independent influences of nondimensional pitch rate and Reynolds number upon uusteady boundary-layer reversal and transition. Temporal and spatial relationships between unsteady boundary-layer reversal and transition imply that unsteady boundary-layer reversal is a precursor and principal determinant in unsteady boundary-layer transition. Comprehension of these and other fundamental unsteady flow physics are crucial for the control of dynamically separated flows generated by maneuvering aircraft, rotorcraft, and wind energy machines.
Author (AIAA)
Reynolds Number; Boundary Layer Transition; Boundary Layer Separation; Unsteady Aerodynamics; Pitching Moments; Airfoils; Transition Flow

19980069442
Separated flows around spoilers and forward-facing flaps
Yeung, W. W. H., Nanyang Technological Univ., Singapore; Xu, C., Nanyang Technological Univ., Singapore; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 53-59; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents experimental studies on the wall pressure and sectional force induced by the flows around a spoiler and a forward-facing flap mounted on a flat surface under various situations. When the spoiler and flap are stationary, the Cp distributions are similar because the flows are associated with an upstream zone where the pressure builds up gradually and a recirculating region downstream in which Cp is less than 0. The latter is bound by a shear layer from the spoiler/flap tip and a reattachment point on the surface, and its extent is dependent upon the spoiler/flap inclination. Base venting changes the flow structures by creating another shear layer from the additional tip so that the recirculating region becomes a wake. The resulting wall pressure and the overall sectional force components are found to vary appreciably with the gap size. When a nonvented spoiler undergoes a rapid rotation, a nonlinear pressure variation caused by a strong starting vortex shed from the spoiler tip is recorded downstream. The nonlinearity is found to decrease with increasing base-venting because of a counter-rotating starting vortex shed from the lower tip of the spoiler, as confirmed by flow visualization. However, when a forward-facing flap with or without base venting undergoes such a rapid motion, a relatively weak vortical flow is found such that the pressure induced is more monotonic, as well as the sectional force. Hence, the studies indicate that the use of forward-facing flaps may have smaller transient adverse effects if mounted on airfoils.
Author (AIAA)
Separated Flow; Spoilers; Flaps (Control Surfaces); Wall Pressure; Force Distribution

19980069446
Numerical analysis of the interference effect of propeller slipstream on aircraft flowfield
Qin, E., Northwestern Polytechnical Univ., China; Yang, Guowei, Northwestern Polytechnical Univ., China; Li, Fengwei, Northwestern Polytechnical Univ., China; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 84-90; In English; Copyright; Avail: Aeroplus Dispatch

The panel method was used for the numerical calculations in this study. A propeller vortex system rotating with its blades and a steady horseshoe vortex system distributed on the aircraft surface were used as the mathematical model. Neumann boundary conditions were satisfied at the panel control points of the blade and the aircraft panel to achieve coupling of propeller slipstream with the whole flowfield of the aircraft. At each corresponding azimuth angle of the propeller, pressure coefficients and induced velocities by the two vortex systems at the panel control points were calculated. From this, the average aerodynamic characteristics of the aircraft in one revolution period were obtained. The contraction effect of the 3-D propeller slipstream and its influence on the flowfield were considered in the computation. Results of numerical examples showed that the slipstream had a significant

effect on aircraft lift characteristics such as flap deflection, resulting in relatively large changes of the aircraft moment performance. Numerical results were in good agreement with the experimental data. The method presented here is suitable for both single- and multiple-propeller aircraft.
Author (AIAA)
Propeller Slipstreams; Panel Method (Fluid Dynamics); Computational Fluid Dynamics; Aerodynamic Interference; Flow Distribution; Aerodynamic Characteristics

19980069456

Sensitivity of subsonic stability derivatives of free aircraft to geometric/tip-store parameters

Joshi, Ashok, Indian Inst. of Technology, India; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 154, 155; In English; Copyright; Avail: Aeroplus Dispatch

Modern-day fighter aircraft are designed to carry heavier accessories at the wingtips in the form of warheads/auxiliary fuel tanks, which have a different mass and center of gravity, depending on the mission. At large flight dynamic pressures, stability derivatives are altered significantly because of structural flexibility. Also, for a free aircraft, the static aeroelastic corrections to the stability derivatives are substantially different because of elastic deformations caused by inertia forces resulting from accelerations. In this context, the inertia configuration of a tip store vis-a-vis the aircraft inertia and wing geometric properties assumes special significance, as it has the potential to alter the overall inertia force distribution and, thereby, the flexible stability derivatives. It is therefore desirable to understand the nature of changes in the flexibile stability derivatives because of different wing geometry and tip-store mass configuration for a generic fighter aircraft wing configuration. This study investigates these sensitivities for a small-aspect-ratio wing in a symmetric subsonic flight for different tip-store inertia configurations.
AIAA
Stability Derivatives; External Stores; Wing Tips

19980069460

Control of leading-edge vortices with suction

Badran, B., Cincinnati, Univ., USA; McCormick, S., Cincinnati, Univ., USA; Gursul, I., Cincinnati, Univ., USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 163-165; In English
Contract(s)/Grant(s): F49620-93-1-0516; Copyright; Avail: Aeroplus Dispatch

The main objective of this work is to explore the feasibility of vortex control by using suction via a slit on the upper surface of a delta wing. Depending on the location and magnitude of the suction, the location and strength of the leading-edge vortex may be controlled. This can be used to alter the swirl angle and streamwise pressure gradient, which are known to be the main parameters affecting the vortex breakdown. Thus, experiments were conducted to explore the effectiveness of surface suction on vortex breakdown. Suction was found to be more effective in delaying vortex breakdown for suction slits closer to the leading edge. The exact mechanism of how the surface suction affects vortex breakdown is not clear. However, surface suction is less effective than the leading-edge suction.
AIAA
Leading Edges; Vortex Breakdown; Suction; Delta Wings

19980069540

Aerodynamic design - The numerical contribution ***La conception aerodynamique - Apport du numerique***

Monnerie, Bernard, ONERA, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Jun. 1997; ISSN 1247-5793, no. 3, pp. 78-83; In French; Copyright; Avail: Aeroplus Dispatch

Numerical prediction methods and tests are intimately associated in the processes of design and implementation of aerospace materials. This is essential, because these methods each have their advantages and their weaknesses, and they are, in fact, very complementary. This article deals with the question of what the numerical contribution is in this process. The issues discussed are when and how calculations intervene in the design process, in what way do numerical methods contribute to cost reduction, and how to minimize the costs of numerical calculations.
AIAA
Spacecraft Construction Materials; Prediction Analysis Techniques; Cost Reduction; Multigrid Methods; Convergence; Numerical Analysis

19980070117

Effect of leading-edge suction on the performance of a high-lift HLF airfoil ***Effet d'une aspiration de bord d'attaque sur les performances d'un profil HLF hypersustente***

Moens, F., ONERA, France; ONERA, TP no. 1997-16; 1997; In French

Report No.(s): ONERA, TP no. 1997-16; Copyright; Avail: Aeroplus Dispatch

This paper presents the main results of ONERA's activities on the high lift of a generic HLF airfoil for transport aircraft, called OALT25. A Krueger flap is the leading-edge high-lift device of this airfoil, the trailing-edge device being a single slotted flap. Based on experimental investigations carried out in the ONERA-F1 wind tunnel in 2-D flow at flight Mach and Reynolds numbers, the takeoff performance of this high-lift device is presented, including the effect of the different suction distributions on CL(max) and CD. Then the optimal suction distribution is deduced by taking into account the power required by the suction device. Introducing simple models in today's CFD codes leads to satisfactory agreement between experimental results and computations, showing the possibility of determining the optimal suction law using CFD tools.

Author (AIAA)

Suction; Leading Edges; Lift Augmentation

19980070118

Engineering study of laminarity in general aviation ***Etude technologique de laminarite en aviation generale***

Rodde, A. M., ONERA, France; Matharan, P., SOCATA, France; ONERA, TP no. 1997-17; 1997; In French

Report No.(s): ONERA, TP no. 1997-17; Copyright; Avail: Aeroplus Dispatch

The purpose of this paper is to present the activities of SOCATA and ONERA in the field of the adaptation of natural laminar flow to business aircraft, covering both performance and engineering problems encountered in maintaining large extents of laminar flow. A single engine aircraft, with cruise Mach numbers between 0.35 and 0.5 at cruise altitudes between 20,000 and 30,000 ft is the application of this study. The first part of the paper involves the optimization of an airfoil for cruise conditions and its wind tunnel testing. The design of the wing is also presented. The second part deals with the investigation of the effects of various types of roughness and surface imperfections on laminar flow and gives the necessary tolerances for the manufacturing of a laminar wing. Finally, the flight test preparation of two laminar gloves is described. These tests will validate the theoretical and wind tunnel results.

Author (AIAA)

General Aviation Aircraft; Laminar Flow

19980070154

Solving an integral equation of the wing theory by the Galerkin method ***OSObennosti resheniya integral'nogo uravneniya teorii kryla metodom Galerkina***

Nugmanov, Z. Kh., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Ovchinnikov, V. A., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 47-50; In Russian; Copyright; Avail: Aeroplus Dispatch

An integral equation of the first kind, which is well known in the wing theory, is solved by using the Galerkin method. by converting test functions to zero at the ends of an interval, the integral equation is modified by changing the kernel and the right term. As a result, the main values of the integral can be calculated in a simple manner, and the accuracy and efficiency of the method are improved.

AIAA

Wing Profiles; Integral Equations; Galerkin Method; Potential Flow; Pressure Distribution

19980070155

Numerical studies of the effect of the curvature and relative thickness of a wing airfoil on the lift coefficient ***Chislennye issledovaniya vliyaniya krivizny i otnositel'noj tolshchiny krylovogo profilya na koehffitsient pod''emnoj sily***

Pavlov, V. G., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Peshatov, G. D., Marijskij Gosudarstvennyj Tekhnicheskij Univ., Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 51-55; In Russian; Copyright; Avail: Aeroplus Dispatch

The dependence of the lift coefficient of a wing airfoil on the relative thickness and curvature of the airfoil is investigated numerically. The treatment is based on the approximation of an ideal incompressible fluid and employs methods developed in

earlier studies (Ermolenko and Ryaguzov, 1984; Peshatov and Markelov, 1980). The invariance of the lift coefficient with respect to the relative thickness and the relative curvature of the airfoil is demonstrated.
AIAA
Wing Profiles; Thickness Ratio; Lift; Aerodynamic Coefficients; Incompressible Flow; Aircraft Design

19980070228
A study of flows near blunt bodies under conditions of partial chemical equilibrium using equations of a laminar boundary layer ***Issledovanie techenij okolo zatuplennykh tel v usloviyakh chastichnogo khimicheskogo ravnovesiya v ramkakh uravnenij laminarnogo pogranichnogo sloya***
Sakharov, V. I., Russia; Suslov, O. N.; Fateeva, E. I.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Apr. 1997; ISSN 0568-5281, no. 2, pp. 96-102; In Russian; Copyright; Avail: Aeroplus Dispatch
A numerical investigation of solutions for equations of a laminar boundary layer at the critical line of blunt bodies indicates that the partial chemical equilibrium model is valid for hypersonic flow past blunt bodies over a wide range of body sizes, altitudes, and velocity of entry into the Earth atmosphere. For the flow conditions investigated, the partial chemical equilibrium model and a model which fully accounts for the nonequilibrium characteristics of all the homogeneous chemical reactions produce very similar results, in contrast to the chemical equilibrium model.
AIAA
Laminar Boundary Layer; Blunt Bodies; Chemical Equilibrium; Boundary Layer Equations; Hypersonic Flow; Atmospheric Entry

19980070230
Existence of self-similar solutions in the supercritical region of hypersonic flow past a delta wing ***K voprosu sushchestvovaniya avtomodel'nykh reshenij v zakriticheskoj oblasti pri giperzvukovom obtekanii treugol'nogo kryla***
Dudin, G. N., Russia; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Apr. 1997; ISSN 0568-5281, no. 2, pp. 156-164; In Russian; Copyright; Avail: Aeroplus Dispatch
Flow past thin semiinfinite delta wings under conditions of strong viscous interaction is investigated in the case where the wing surface temperature is low in comparison with the stagnation temperature of the incoming flow. Wings are considered which are characterized by a power-law thickness variation in the transverse direction with an exponent of 3/4. Results of a numerical calculation of the boundary layer flow characteristics in both critical and subcritical regions of the flow are presented.
AIAA
Delta Wings; Subcritical Flow; Aerodynamic Heat Transfer; Hypersonic Flow

19980070232
Design of wing airfoils for subsonic gas flow using numerical optimization methods ***Postroenie krylovykh profilej v dozvukovom potoke gaza metodami chislennoj optimizatsii***
Aul'chenko, S. M., Russia; Latypov, A. F.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Apr. 1997; ISSN 0568-5281, no. 2, pp. 174-182; In Russian; Copyright; Avail: Aeroplus Dispatch
The shapes of subsonic wing airfoils with specified characteristics are determined by using a method for solving problems in the design of optimal two-dimensional configurations. The approach is based on a modified version of the boundary element method for determining the external flow. The accuracy of the method is evaluated.
AIAA
Wing Profiles; Subsonic Flow; Finite Element Method; Aerodynamic Characteristics; Aerodynamic Coefficients

19980070234
Numerical modeling of a pseudodiscontinuity in a plane channel produced by the combustion of wall hydrogen jets ***Chislennoe modelirovanie psevdoskachka v ploskom kanale, vyzvannogo sgoraniem pristennykh vodorodnykh struj***
Kolesnikov, O. M., Russia; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Apr. 1997; ISSN 0568-5281, no. 2, pp. 196-200; In Russian; Copyright; Avail: Aeroplus Dispatch
Results of a numerical simulation of the ignition and combustion of underexpanded turbulent hydrogen jets injected into subsonic air flow along the walls of a plane channel are presented. The calculations are based on the numerical integration of parabolized Navier-Stoke equations by the global iteration method with allowance for the finite chemical reaction rates. The structure of the generated pseudodiscontinuity is shown to depend on the Mach number of the air stream.
AIAA
Gas Jets; Turbulent Jets; Supersonic Flow; Ignition Limits; Shock Wave Interaction

19980070563

Experimental study on the effect of unsteadiness on boundary layer development on a linear turbine cascade

Schobeiri, M. T., Texas A & M Univ., College Station, USA; Pappu, K., Texas A & M Univ., College Station; Experiments in Fluids; Aug. 1997; ISSN 0723-4864; Volume 23, no. 4, pp. 306-316; In English; Copyright; Avail: Aeroplus Dispatch

The results from an experimental investigation of unsteady boundary layer behavior on a linear turbine cascade are presented. to perform a detailed study on unsteady cascade aerodynamics and heat transfer, a new large-scale, high-subsonic research facility for simulating the periodic unsteady flow has been developed. It is capable of sequentially generating up to four different unsteady inlet flow conditions that lead to four different passing frequencies, wake structures, and freestream turbulence intensities. For a given Reynolds number, two different unsteady wake formations are used. Detailed unsteady boundary layer velocity, turbulence intensity, and pressure measurements are performed along the suction and pressure surfaces of one blade. The results display the transition and development of the boundary layer, ensemble-averaged velocity, and turbulence intensity.

Author (AIAA)

Unsteady Aerodynamics; Turbine Blades; Cascade Flow; Aerodynamic Heat Transfer; Boundary Layer Flow

19980070567

Vortex breakdown over a delta wing with oscillating leading edge flaps

Deng, Q., Cincinnati, Univ., USA; Gursul, I., Cincinnati, Univ., USA; Experiments in Fluids; Aug. 1997; ISSN 0723-4864; Volume 23, no. 4, pp. 347-352; In English; Copyright; Avail: Aeroplus Dispatch

The effects of oscillating leading-edge flaps on leading-edge vortices and vortex breakdown were investigated for a delta wing with upward-deflected flaps. The variation of breakdown location revealed hysteresis loops. The time-averaged breakdown location over one cycle may move upstream or downstream compared to the quasi-steady case, depending on the amplitude of flap oscillations and angle of attack. Measurements of the phase-averaged velocity upstream of breakdown did not reveal any correlation to the response of breakdown location. The effect of oscillating flaps is largest when the breakdown location is near the trailing-edge region in the static case.

Author (AIAA)

Delta Wings; Vortex Breakdown; Leading Edge Flaps; Wing Oscillations; Trailing Edges

19980071166

Interaction between a supersonic hot jet and a coaxial supersonic flow

Rodriguez, O., ONERA, France; Desse, J. M., ONERA, France; Pruvost, J., ONERA, France; Aerospace Science and Technology; Nov. 1997; ISSN 0034-1223; Volume 1,, no. 6, pp. 369-379; In English; Copyright; Avail: Aeroplus Dispatch

The structure of a supersonic hot jet at Mach 1.8 injected into a coaxial supersonic flow at Mach 1.5 is analyzed by differential interferometry, the total pressure ratio being a variable parameter. Density profiles are deduced assuming the flow to be axisymmetric. The flow is characterized by a very stable region downstream of two conical shocks and by a region located between the injection plane and the second conical shock where viscosity is locally nonnegligible and the jet exhibits high gradients permitting the transition from injection conditions to the far-field stabilized flow conditions. Density profiles superimposed on the visualizations show that the minima are always located along the boundary of the potential cone and the reflected shocks and, further downstream, along the boundary between the inner and outer parts of the jet.

Author (AIAA)

Supersonic Jet Flow; Coaxial Flow; Flow Characteristics; Flow Stability; Density Distribution

19980071229

Aerothermal calculations for the radomes and IRdomes of supersonic missiles ***Calculs aerothermiques pour les radomes et IRdomes de missiles supersoniques***

Canal, Bruno, ONERA, France; Luc-Bouhali, Agnes, ONERA, France; ONERA, TP no. 1997-28; 1997; In French

Report No.(s): ONERA, TP no. 1997-28; Copyright; Avail: Aeroplus Dispatch

Aerothermal calculation codes used at the Direction des Etudes de Synthese for simulating the heating of supersonic-vehicle radomes and IRdomes are presented. Problems associated with determining the outer flow transition between the laminar and turbulent states are examined, and point to the need for aerothermal/thermal coupling. A number of calculation examples are presented.

AIAA

Supersonic Flight; Missiles; Aerothermodynamics; Radomes; Laminar Flow; Turbulent Flow

19980071340

Parallelization and dynamic load balancing of NPARC codes

Gopalaswamy, N., Indiana Univ.-Purdue Univ., Indianapolis, USA; Akay, H. U., Indiana Univ.-Purdue Univ., Indianapolis; Ecer, A., Indiana Univ.-Purdue Univ., Indianapolis; Chien, Y. P., Indiana Univ.-Purdue Univ., Indianapolis; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1806-1812; In English

Contract(s)/Grant(s): NAG3-1577

Report No.(s): AIAA Paper 96-3302; Copyright; Avail: Aeroplus Dispatch

Parallelization and dynamic load balancing of the 2-D and 3-D NPARC flow codes are presented. A previously developed parallel database package, GPAR, and a dynamic load balancer program, DLB, are used for both the 2-D and the 3-D versions of NPARC. Performance characteristics of the implemented algorithms in 2-D and 3-D internal flow configurations are explored. Dynamic load balancing studies are carried out with the two parallel codes for an engine inlet configuration. The benchmark cases consist of a 2-D case with 4592 grid points and two 3-D cases, one with 50,950 grid points and the other with 240,000 grid points. The grids are decomposed into solution blocks, and parallel computations are carried out with a varying number of processors. The pressure response to unsteady perturbations of the inlet temperature is calculated using a variable time-stepping approach specifically developed for parallel computations which takes into account the time-step variations in blocks with selective communication between the blocks. Load balancing is effective in large cases in which block computation costs are more dominant than communication costs.

Author (AIAA)

Two Dimensional Flow; Three Dimensional Flow; Computer Programs; Parallel Computers; Dynamic Loads; Force Distribution; Parallel Processing (Computers); Computational Fluid Dynamics

19980071343

Prediction of active control of subsonic centrifugal compressor rotating stall

Lawless, P. B., Purdue Univ., USA; Fleeter, S., Purdue Univ., USA; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1829-1836; In English; Copyright; Avail: Aeroplus Dispatch

A mathematical model is developed to predict the suppression of rotating stall in a centrifugal compressor with a vaned diffuser. This model is based on the employment of a control vortical waveform generated upstream of the impeller inlet to damp weak potential disturbances that are the early stages of rotating stall. The control system is analyzed by matching the perturbation pressure in the compressor inlet and exit flowfields with a model for the unsteady behavior of the compressor. The model was effective at predicting the stalling behavior of the Purdue Low-Speed Centrifugal Compressor for two distinctly different stall patterns. Predictions made for the effect of a controlled inlet vorticity wave on the stability of the compressor show that, for minimum control wave magnitudes, on the order of the total inlet disturbance magnitude, significant damping of the instability can be achieved. For control wave amplitudes of sufficient amplitude, the control phase angle appears to be the most important factor in maintaining a stable condition in the compressor.

Author (AIAA)

Active Control; Rotating Stalls; Centrifugal Compressors; Subsonic Speed; Mathematical Models; Prediction Analysis Techniques

19980071344

Measurements in rollup region of the tip vortex from a rectangular wing

Ramaprian, B. R., Washington State Univ., Pullman, USA; Zheng, Youxin, Washington State Univ., Pullman; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1837-1843; In English

Contract(s)/Grant(s): DAAL03-87-G-0011; DAAL03-91-G-0026; AF-AFOSR-90-0131; Copyright; Avail: Aeroplus Dispatch

The evolving 3-D flowfield of the tip vortex in the near wake of a rectangular wing at incidence was studied in detail using three-component laser Doppler velocimetry. The flow quantities measured were the three components of the instantaneous velocity. These data were used to obtain the distributions of velocity, vorticity, and circulation across the vortex at several axial locations in the flow for several angles of incidence. The data have been used to understand the process of rollup of the shear layer into the vortex in the near wake as well as its kinematic structure. The data indicate that the rollup takes place quite quickly and the inner part of the 3-D vortex becomes nearly axisymmetric within a distance of about two chord lengths downstream of the trailing edge. Even though the vortex behavior in the near wake is, in general, strongly dependent on the initial conditions, the vortex trajectory appears to be described reasonably well by the overall wing lift and the freestream velocity. Also, even in the near wake, circumfer-

entially averaged mean flow properties in the inner part of the nearly axisymmetric vortex begin to exhibit a universal structure characteristic of conceptual asymptotic trailing vortices.
Author (AIAA)
Vortices; Wing Tips; Rectangular Wings; Three Dimensional Flow; Shear Layers

19980071351
Gurney flap scaling for optimum lift-to-drag ratio
Giguere, Philippe, Univ. Laval, Canada; Dumas, Guy, Univ. Laval, Canada; Lemay, Jean, Univ. Laval, Canada; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1888-1890; In English; Copyright; Avail: Aeroplus Dispatch

Evidence is provided that there exists a flow-based scaling for the Gurney flap heights that yields an increase in lift-to-drag performance compared with the baseline airfoil at the same angle of attack (beneficial Gurney flaps). The results presented here support this statement and further suggest that the boundary layer thickness delta, measured at the trailing edge on the pressure side of the baseline airfoil, is not only an appropriate flow-based normalization for the flap height but is also a proper order of magnitude for the flap height providing the large increase in the L-D ratio (optimum Gurney flap). The choice of delta (as just defined) as a proper scaling for the optimum Gnrney flap incorporates the combined effects of airfoil geometry, angle of attack, Reynolds number, and flow regime.
AIAA
Lift Drag Ratio; Flaps (Control Surfaces); Flight Optimization

19980071352
Studies on alleviation of buffet in periodic transonic flow
Raghunathan, S. R., Belfast, Queen’s Univ., UK; Gillan, M. A., Belfast, Queen’s Univ., UK; Mitchell, R. D., Belfast, Queen’s Univ., UK; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1890, 1891; In English; Copyright; Avail: Aeroplus Dispatch

The paper presents results of a transonic CFD study performed on a biconvex airfoil with a splitter plate extension or with surface cooling. The effects of the trailing-edge splitter plate and surface heat transfer on periodic shock motion in transonic flows were investigated. The results indicate that the periodic motion on rigid biconvex airfoils can be predicted with the 2-D thin-layer N-S code developed here. Splitter plate extension or surface cooling changed the type of shock motion or completely attenuated it.
AIAA
Transonic Flow; Computational Fluid Dynamics; Buffeting; Aerodynamic Stability; Heat Transfer; Periodic Variations; Motion Stability; Plates (Structural Members)

19980071358
Experimental rarefied density flowfields at hypersonic conditions over 70-degree blunted cone
Allegre, J., CNRS, France; Bisch, D., CNRS, France; Lengrand, J. C., CNRS, France; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 714-718; In English; Copyright; Avail: Aeroplus Dispatch

At rarefied flow regimes, flow-field investigations have been conducted in the SR3 wind tunnel on a 70-deg spherically blunted cone and density flow fields obtained by nonintrusive electron beam fluorescence measurements. The blunted cone, chosen as the test case model, has been the subject of extensive studies during the past few years. This research gathers density flow fields obtained experimentally at two rarefied hypersonic flow conditions. Experiments were performed at a freestream Mach number close to 20 and for two Reynolds numbers, 1420 and 4175, calculated using freestream conditions and the cone base diameter. Density flow fields are presented for the two angles of attack, 0 and 10 deg, of the cone. In parallel with the experimental work presented, a number of flow-field calculations were executed for test conditions identical to SR3 test conditions. Flow fields were calculated using direct simulation Monte Carlo solutions, leading to comparisons between experimental and computational flow fields.
Author (AIAA)
Rarefied Gas Dynamics; Hypersonic Wind Tunnels; Flow Distribution; Hypersonic Flow; Blunt Bodies; Cones; Flow Measurement

19980071359
Experimental rarefied aerodynamic forces at hypersonic conditions over 70-degree blunted cone
Allegre, J., CNRS, France; Bisch, D., CNRS, France; Lengrand, J. C., CNRS, France; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 719-723; In English; Copyright; Avail: Aeroplus Dispatch

The blunted cone has been chosen as a test case model to provide both experimental and computational data bases in the field of hypersonic and rarefied flow conditions. The present work, focused on aerodynamic forces, gives a complete set of experimental data. Experiments have been conducted in the SR3 facility at a freestream Mach number close to 20 and for Reynolds numbers ranging from 1522 to 34,855, calculated using freestream conditions and the model base diameter. Aerodynamic forces and moments are presented for three levels of flow rarefaction and for model angles of attack between 0 and 30 deg. In parallel with the experimental work, flow calculations were made by an international group of researchers for identical test conditions. Examples of comparisons between experimental and computational aerodynamic forces are also indicated.
Author (AIAA)
Rarefied Gas Dynamics; Aerodynamic Forces; Hypersonic Flow; Blunt Bodies; Cones; Flow Distribution; Hypersonic Wind Tunnels

19980071360

Experimental rarefied heat transfer at hypersonic conditions over 70-degree blunted cone

Allegre, J., CNRS, France; Bisch, D., CNRS, France; Lengrand, J. C., CNRS, France; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 724-728; In English; Copyright; Avail: Aeroplus Dispatch

Surface heat transfer rates have been measured over a 70-deg spherically blunted cone chosen as a test case model to provide both experimental and computational data bases. Under rarefied and hypersonic conditions, heating rate distributions are measured along the model and presented at angles of attack varying from 0 to 30 deg. Experiments have been conducted in the SR3 facility at a freestream Mach number close to 20. Three flow rarefactions have been considered, which correspond to Reynolds numbers of 1420, 4175, and 36,265. Reynolds numbers are calculated using freestream conditions and the model base diameter. In parallel with the experimental work, flow calculations were execute for identical test conditions. Comparisons between experimental and computational heating rates are also presented.
Author (AIAA)
Rarefied Gas Dynamics; Hypersonic Flow; Blunt Bodies; Cones; Hypersonic Wind Tunnels; Hypersonic Heat Transfer

19980071362

Base cavity effects on the aerodynamic characteristics of a hypersonic flared projectile

Fournier, E. Y., Defence Research Establishment Valcartier, Canada; Dupuis, A. D., Defence Research Establishment Valcartier, Canada; Edwards, J. A., Defence Research Agency, UK; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 737-743; In English; Copyright; Avail: Aeroplus Dispatch

To gain an insight into the complex flow structure in the base region of a projectile with a base cavity, a hypersonic cone-cylinder-flare projectile is investigated through computational means, and the results are compared with free-flight experimental results. Aerodynamic coefficients, base pressure surveys, base flow visualization, and shock patterns over the projectile are investigated for a Mach number range of 3.5-5.75. Several base cavity depths are selected to identify the effects of cavity depth on a range of aerodynamic coefficients. Correlation between experimental and numerical values seems to show the absence of a relation between the aerodynamic coefficients, such as drag, normal force, and pitching moment, and the presence of a base cavity for this particular configuration. Variations in the depth parameter of the base cavity presented similar results.
Author (AIAA)
Cavity Flow; Aerodynamic Characteristics; Projectiles; Hypersonic Speed; Flow Geometry; Base Flow; Flow Distribution; Flared Bodies

19980071363

Methods for distributing semiempirical, nonlinear, aerodynamic loads on missile components

Moore, F. G., U.S. Navy, Naval Surface Warfare Center, USA; McInville, R. M., U.S. Navy, Naval Surface Warfare Center, USA; Housh, Clint, U.S. Navy, Naval Surface Warfare Center, USA; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 744-752; In English; Copyright; Avail: Aeroplus Dispatch

New methodology has been added to the U.S. Naval Surface Warfare Center, Dahlgren Division, Aeroprediction code to permit the distribution of the local linear and nonlinear aerodynamic loads along the body length and over the wing and tail lifting surfaces. The new techniques extend to both the Phi = 0 and 45 deg roll positions and to both windward and leeward lifting surfaces in the 45-deg roll orientation. The local loads are integrated to get the distribution of the shear and bending moments for use in structural analysis and design. Navier-Stokes CFD computations for a wing-body-tail missile configuration were used in the

development of these extensions of the code and in validating their effectiveness. In general, good agreement with total force and moment experimental data and the CFD results is obtained.
Author (AIAA)
Aerodynamic Loads; Missile Components; Semiempirical Equations; Nonlinear Equations; Force Distribution; Body-Wing and Tail Configurations; Missile Design

19980071364
Navier-Stokes predictions of pitch damping for axisymmetric projectiles
Weinacht, Paul, U.S. Army, Research Lab., USA; Sturek, Walter B., U.S. Army, Research Lab., USA; Schiff, Lewis B., NASA Ames Research Center, USA; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 753-761; In English; Copyright; Avail: Aeroplus Dispatch

An approach for predicting the pitch-damping coefficient sum for axisymmetric flight bodies is presented. The approach utilizes a specific combination of spinning and coning motions that allows the pitch-damping force and moment coefficient to be directly related to the aerodynamic side force and moment. The use of combined spinning and coning motion represents an improvement over existing techniques that utilize lunar coning motion for predicting the pitch-damping coefficients. A parabolized Navier-Stokes approach that utilizes a missile-fixed, noninertial rotating coordinate frame is applied to predict the flow fields about axisymmetric projectiles undergoing steady coning motion. The governing equations are modified to include the centrifugal and Coriolis force terms due to the rotating coordinate frame. From the computed flow field, the side force and moment due to coning motion, spinning motion, and combined spinning and coning motion are used to determine the pitch-damping coefficients. Computations are performed for a generic shell configuration (with and without boattail), and the predictions show good agreement with an existing inviscid code. The comparisons of computational results for a family of ogive-cylinder configurations with aerodynamics range data show excellent agreement and further validate the approach.
Author (AIAA)
Axisymmetric Bodies; Coning Motion; Navier-Stokes Equation; Pitch (Inclination); Damping; Aerodynamic Stability; Prediction Analysis Techniques; Aerodynamic Coefficients; Missile Control

19980071365
Control effectiveness of a jet-slender body combination at hypersonic speeds
Kontis, K., Cranfield Univ., UK; Stollery, J. L., Cranfield Univ., UK; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 762-768; In English; Copyright; Avail: Aeroplus Dispatch

The effects of jet control on the aerodynamic characteristics, performance, and stability of a 5-deg semiangle slender cone missile configuration are studied. Tests were made in the Cranfield University College of Aeronautics hypersonic gun tunnel using both sharp and blunted cones. The study was conducted at a Mach number of 8.2 and a Reynolds number of 392,700, based on base diameter, at pitch angles of -15 to 15 deg. The boundary layer was laminar. Air was used as the working gas for both the freestream and the sonic jet. The tests employed schlieren photography to study the overall flow field. Quantitative studies of the effect of the jet have been made by pressure measurements. The forces were measured with a three-component balance equipped with semiconductor strain gauges.
Author (AIAA)
Hypersonic Flight; Missile Control; Aerodynamic Characteristics; Aerodynamic Stability; Slender Bodies; Slender Cones; Jet Flow

19980071386
Studies on enhancement techniques for mixing and combustion in supersonic flows
Chen, Jianqiang, China Aerodynamics Research and Development Center, Mianyang, China; Zhang, Hanxin, China Aerodynamics Research and Development Center, Mianyang; Gao, Shuchun, China Aerodynamics Research and Development Center, Mianyang; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 27-31; In Chinese; Copyright; Avail: Aeroplus Dispatch

Viscous nonequilibrium swirling flows in a divergent duct are simulated by solving the N-S equations, and enhancement techniques for mixing and combustion in supersonic flows are investigated. The results show that the swirling of fuel is an effective enhancement method for supersonic mixing and combustion.
Author (AIAA)
Supersonic Flow; Supersonic Combustion Ramjet Engines; Nonequilibrium Flow; Combustion Efficiency

19980071391

Vectorization of the implicit solution for chemical nonequilibrium flow over a reentry vehicle

Zeng, Ming, National Univ. of Defense Technology, China; Wang, Zhenghua, National Univ. of Defense Technology, China; Liu, Jun, National Univ. of Defense Technology, China; Qu, Zhanghua, National Univ. of Defense Technology, China; Chen, Hong, National Univ. of Defense Technology, China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 50-52; In Chinese; Copyright; Avail: Aeroplus Dispatch

A numerical simulation code for chemical nonequilibrium flow over a reentry vehicle is vectorized on the YH-2 supercomputer. The speedup ratio of vectorization reaches 3.4 after reconstruction and optimization of the scalar code. This is a successful attempt at vectorizing the Navier-Stokes equations' implicit solution for chemical nonequilibrium flow, and it provides a good basis for parallel processing of the code.

Author (AIAA)

Reentry Vehicles; Reacting Flow; Nonequilibrium Flow; Vector Processing (Computers)

19980071394

A general method for predicting aerodynamic stability in multistage axial compression systems under inlet flow distortion

Wu, Hu, Northwestern Polytechnical Univ., China; Lian, Xiaochun, Northwestern Polytechnical Univ., China; Chen, Fuqun, Northwestern Polytechnical Univ., China; Cui, Jianyong, Northwestern Polytechnical Univ., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 62-64; In Chinese; Copyright; Avail: Aeroplus Dispatch

A general numerical method is developed for predicting aerodynamic stability in multistage axial compression systems with inlet combined pressure and temperature distortion based on a stage-by-stage parallel compression system model. Predictions for two multistage axial flow compressors are given using this method. Quantitative relationships between the inlet total pressure distortion, total temperature distortion, or combined pressure and temperature distortion and the surge margin losses are obtained. It is found that the effects of aligned pressure and temperature distortion on the aerodynamic stability of axial compressors are the strongest.

Author (AIAA)

Turbocompressors; Aerodynamic Stability; Inlet Flow; Flow Distortion; Inlet Temperature

19980071417

Aerodynamic drag reduction ***Reduction de la trainee aerodynamique***

Cousteix, Jean, ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Schmitt, Volker, ONERA, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Feb. 1997; ISSN 1247-5793, no. 1, pp. 34-41; In French; Copyright; Avail: Aeroplus Dispatch

The drag breakdown of various aircraft (business jets, civil transport aircraft of the Airbus type, and the Concorde) has three main sources: the friction drag, the induced drag (drag due to lift) and the form drag (or pressure drag). ONERA has conducted many studies devoted to reduce these various drag sources. In this paper, four studies have been chosen to exemplify these efforts. These studies involve cambered trailing edge profiles, turbines at wing tips, riblets, and laminarization techniques.

AIAA

Drag Reduction; General Aviation Aircraft; European Airbus

19980071447

Parallel high-order dense matrix inversion and applications

Chen, Jun, National Univ. of Defense Technology, China; Wang, Zhenghua, National Univ. of Defense Technology, China; Li, Xiaomei, National Univ. of Defense Technology, China; National University of Defense Technology, Journal; Aug. 1997; ISSN 1001-2486; Volume 19, no. 4, pp. 1-4; In Chinese; Copyright; Avail: Aeroplus Dispatch

We propose a Gauss-Jordan algorithm using column interchanges for computing a high-order dense matrix inverse produced by the high-order panel method in aerodynamics. The algorithm implements the block cyclic data distribution, which has communication advantages for the hypercube network. Results are achieved when running this program on the 4 SGI workstations configured as a 2X2 processor grid. It is shown that 57-64 percent efficiency can be attained when solving a matrix of about 1000 order.

Author (AIAA)

Panel Method (Fluid Dynamics); Supersonic Flow; Matrices (Mathematics); Hypercube Multiprocessors

19980071506

On the removal of the trailing edge singularity in 3D flows

Bassanini, P., Roma I, Univ., Italy; Casciola, C. M., Roma I, Univ., Italy; Lancia, M. R., Roma I, Univ., Italy; Piva, R., Roma I, Univ., Italy; 1997, pp. 1-6; In English; Copyright; Avail: Aeroplus Dispatch

It is shown how the Kutta condition can be enforced by removing the singularity of the velocity field u at a 3D airfoil's sharp trailing edge, TE. The velocity u is represented by the Poincare formula and a Hodge-type decomposition for the tangent trace of u under the assumption of a linearized wake analysis. The explicit behavior of u at the trailing edge is determined using analytical results by Kondrat'ev and Oleinik (1983), and the singular (divergent) part is removed. This process yields a functional equation along TE that determines omega, and hence the circulation about each airfoil section, in terms of freestream velocity by enforcing the impermeability condition.

AIAA

Trailing Edges; Singularity (Mathematics); Three Dimensional Flow; Airfoil Profiles; Steady Flow; Incompressible Flow

19980071649

On the prediction of aerofoil unsteady stall criticality

Gracey, M. W., Glasgow, Univ., UK; Coton, F. N., Glasgow, Univ., UK; Galbraith, R. A. McD., Glasgow, Univ., UK; Aeronautical Journal; Sep. 1997; ISSN 0001-9240; Volume 101,, no. 1007, pp. 331-334; In English; Copyright; Avail: Aeroplus Dispatch

A range of criteria which have been used to indicate the onset of dynamic stall are presented. It is observed that, since all of these are based on physical manifestations of the dynamic stall process, they may only provide an indication that the process has started rather than identifying the initiation itself. A more suitable criterion for this is the concept of critical angle, first proposed by Wilby (1980). It is shown that the critical angle, which is normally determined through an extensive program of oscillatory tests on a given airfoil, is achieved in advance of all the other criteria. The present work presents a correlation which has the potential to determine the critical angle, and hence the useful oscillatory range of an airfoil, on the basis of simple ramp function tests.

Author (AIAA)

Unsteady Aerodynamics; Aerodynamic Stalling; Airfoil Oscillations; Ramp Functions

19980072062

A comparison of the capabilities of one- and two-equation differential turbulence models when applied to flows with separation and reattachment - Transonic flow around an airfoil ***SRavnenie vozmozhnostej differentsial'nykh modelej turbulentnosti s odnim i dvumya uravneniyami pri raschete techenij s otryvom i prisoedineniem - Transzvukovoe obtekanie profilya***

Strelets, M. Kh., Rossijskij Nauchnyj Tsentr 'Prikladnaya Khimiya', Russia; Travin, A. K., Rossijskij Nauchnyj Tsentr 'Prikladnaya Khimiya', Russia; Shur, M. L., Rossijskij Nauchnyj Tsentr 'Prikladnaya Khimiya', Russia; Teplofizika Vysokikh Temperatur; Apr. 1997; ISSN 0040-3644; Volume 35, no. 2, pp. 301-313; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of a comprehensive numerical study of the capabilities of three recently proposed one- and two-equation differential turbulence models for calculating various turbulent wall flows with a strong longitudinal pressure gradient and with separation and reattachment are presented. Calculations are carried out for transonic flow around an RAE2822 wing airfoil. The results demonstrate that not only the Spalart-Allmaras model, which has been used before for the analysis of transonic flow around airfoils, but also the other two models (the Menter model and the nu(t)-92 model) provide an acceptable accuracy in calculating the local and integral characteristics of this class of turbulent flows.

AIAA

Turbulence Models; Separated Flow; Transonic Flow; Airfoil Profiles

19980072063

Supersonic flow with gasdynamic and physicochemical inhomogeneities past bodies ***Sverkhzvukovoe obtekanie tel potokom s gazodinamicheskimi i fiziko-khimicheskimi neodnorodnostyami***

Pilyugin, N. N., Moskovskij Gosudarstvennyj Univ., Russia; Talipov, R. F., Moskovskij Gosudarstvennyj Univ., Russia; Khlebnikov, V. S., Moskovskij Gosudarstvennyj Univ., Russia; Teplofizika Vysokikh Temperatur; Apr. 1997; ISSN 0040-3644; Volume 35, no. 2, pp. 322-336; In Russian; Copyright; Avail: Aeroplus Dispatch

Recent studies concerned with the interaction of blunt bodies moving at a supersonic velocity with various gasdynamic and physicochemical inhomogeneities in the atmosphere are briefly reviewed. In particular, attention is given to thermal inhomogeneities, precursor formation during the interaction of a shock wave with a thermal layer, local energy release regions, physicochemical inhomogeneities, and gasdynamic parameter discontinuities.

AIAA

Supersonic Flow; Blunt Bodies; Inhomogeneity; Aerodynamic Characteristics

19980072156

Partly improved lift line algorithms of ram air turbine performance

Zhang, Jianfeng, Beijing Univ. of Aeronautics and Astronautics, China; Liu, Siyong, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 482-486; In Chinese; Copyright; Avail: Aeroplus Dispatch

A modern propeller improved lift line algorithm has been applied to ram air turbine (RAT) performance calculation. The blade modeling is partly improved with the RAT's construction. Comparisons of experiments and improved lift line results carried out for a RAT model show good agreement with experiments, and the distributions of blade circulation and induced velocities are reasonable. Precision and width are improved.

Author (AIAA)

Turbines; Lift; Propellers

19980072273

Evaluation of explicit algebraic Reynolds-stress models for separated supersonic flows

Rizzetta, Donald P., USAF, Wright Lab., USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 1, pp. 24-30; In English Report No.(s): AIAA Paper 97-2125; Copyright; Avail: Aeroplus Dispatch

High-Reynolds-number supersonic flow fields were generated numerically to assess the performance of three explicit algebraic Reynolds-stress turbulence models. The configurations consist of a shock/boundary-layer interaction and a 24-deg compression ramp, both of which exhibit an appreciable region of separated flow. Solutions were also obtained using standard zero-equation and k-epsilon models. Details of the computations are summarized, and the accuracy of numerical results is established via grid resolution studies. Comparisons are made with experimental data in terms of surface pressure and skin friction, as well as off-surface profiles of mean velocity and components of the Reynolds-stress tensor. For the flows considered here, it is found that the algebraic-stress models offer little improvement over existing closures.

Author (AIAA)

Reynolds Stress; Separated Flow; Supersonic Flow; Turbulence Models

19980072580

On the coupling effect of two vortex systems of Chinese aircraft with turbopropellers

E, Qin, Northwestern Polytechnical Univ., China; Yang, Guowei, Northwestern Polytechnical Univ., China; Li, Fengwei, Northwestern Polytechnical Univ., China; Fu, Dawei, Research Inst. No. 603, China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 511-516; In Chinese; Copyright; Avail: Aeroplus Dispatch

Keeping pace with the global development of relatively small commercial passenger aircraft, engineers in China are trying to solve the following difficult aerodynamic problem in aircraft design: prediction of the effect of turbopropeller slipstream on the aerodynamic performance of aircraft. The difficulty lies in the coupling of two vortex systems, the propeller vortex system rotating with its blades and the steady horseshoe vortex system distributed on the aircraft surface. We solved the above-mentioned difficulty through very careful thinking which led to our proposal of two equations which make it possible (1) transform from the moving coordinate axes of the propeller vortex system to the fixed coordinate axes of the aircraft body and vice versa; and (2) to transform the induced velocity in terms of the moving coordinate axes of the propeller vortex system into that in terms of the fixed coordinate axes of the aircraft body and vice versa. We took two numerical examples. It is shown that our computed results are in good agreement with the experimental data given by Favier for a French propeller/nacelle wing configuration at low subsonic speeds. The other numerical example is the Chinese aircraft Yun-7 with two turbopropellers. Our computed results are in good agreement with experimental data for this aircraft.

Author (AIAA)

Propellers; Vortices; Coupling

19980072581

Numerical analysis of three-dimensional viscous compressible flowfields of a rectangular nozzle

You, Yingjiu, Northwestern Polytechnical Univ., China; Zhao, Guiping, Northwestern Polytechnical Univ., China; Shen, Huili, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 517-522; In Chinese; Copyright; Avail: Aeroplus Dispatch

An approach is advanced to simulate the inner turbulent folwfields of a rectangular nozzle with the sweep finite element method. A new discretization method for the second derivatives in Navier-Stokes equations is presented, and formulations of the

sweep finite element equations which are better and simpler than previous formulations are derived. With this approach, some examples are calculated, including the flowfields of the 2-D convergent-divergent nozzle, the rectangular nozzle, and the circular-to-rectangular transition duct with width to height ratio of 4 and 7. The results are in good agreement with experimental data and indicate the efficiency and accuracy of the method.
Author (AIAA)
Numerical Analysis; Three Dimensional Flow; Nozzle Flow

19980072606

Numerical simulation of the unsteady flow through turbomachinery components ***Numerische Simulation der instationaeren Stroemung in Turbomaschinenkomponenten***

Engel, Karl, DLR, Inst. fuer Antriebstechnik, Germany; 1997; In German

Report No.(s): DLR-FB-97-19@ISSN 0939-2963; Copyright; Avail: Aeroplus Dispatch

Different numerical models and algorithms for the calculation of the unsteady flow through turbomachinery components are presented and are discussed in view of the massively parallel computer architecture used. The work begins with the design and implementation of a parallel software environment which is shaped to the specific needs of the application and features an interactive control as one important element. The interactive control unit is directly linked to the flow solver unit by appropriate implementation of a variety of boundary conditions. For reasons of numerical accuracy, high resolution finite difference upwind schemes with TVD properties are considered for the discretization of the convective terms. Using unsteady test cases, the time accuracy of different formulations is assessed in terms of the numerical dissipation and dispersion error. Furthermore, the problem of efficient and fully scaleable parallelization of the numerical methods is addressed. Finally, the usefulness of the developed system is demonstrated by a calculation of the inviscid two-dimensional unsteady flow through a transonic compressor stage. By doing so, typical problems which have been encountered in turbomachinery flow simulations, as for example, efficient initialization, choice of boundary conditions, and numerical solution techniques, are discussed.
Author (AIAA)
Unsteady Flow; Computational Fluid Dynamics; Turbomachinery; Massively Parallel Processors

19980072796

Unsteady cascade aerodynamics in the time domain

Gottfried, Dana A., Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; 1998, pp. 1329-1341; In English

Report No.(s): AIAA Paper 98-1852; Copyright; Avail: AIAA Dispatch

Consideration is given to a linearized unsteady incompressible unsteady aerodynamic model for airfoil cascades which is not restricted to harmonic motion at a constant interblade phase angle. This is accomplished by starting with the unsteady aerodynamic coefficients generated by LINSUB, a linearized unsteady cascade aerodynamics code. An inverse Fourier transform is then performed to predict the unsteady aerodynamic forces on the airfoils due to an impulsive acceleration. This result, termed the cascade indicial function, is then convoluted with the arbitrary motion of the blades to obtain the unsteady aerodynamic forces on the airfoils in the time domain. The aerodynamic damping predicted by the time domain model is then shown to compare well to LINSUB results when the interblade phase angle is constant. Results demonstrating the ability of the model to handle arbitrary airfoil motion are also presented.
Author (AIAA)
Unsteady Aerodynamics; Cascade Flow; Incompressible Flow; Aerodynamic Forces; Airfoil Profiles

19980072974

Comprehensive efficient computations of transonic aeroelasticity

Dornberger, Rolf, Stuttgart, Univ., Germany; Grohmann, Boris, Stuttgart, Univ., Germany; Kroeplin, Bernd, Stuttgart, Univ., Germany; Dinkler, Dieter, Braunschweig, Technical Univ., Germany; 1998, pp. 3111-3121; In English

Report No.(s): AIAA Paper 98-2073; Copyright; Avail: AIAA Dispatch

In the field of aeroelasticity, a method has been developed for the efficient computation of inviscid flows and their influence on the dynamic behavior of elastic structures in the transonic flow regime. The lack of simple models for describing aerodynamic loads precisely, by exactly localizing and quantifying occurring shocks, is typical for transonic aeroelasticity. Numerical methods bridge this gap, but only with higher computational costs. This paper is concerned with modeling and discretization of the aeroelastic multilevel problem, which consists of unsteady aerodynamics and dynamics of geometrically nonlinear structures, and demon-

strates the use of efficient solution strategies, such as adaptive multigrid methods. The aerodynamic loads are computed on given structures with the stabilized finite space-time element method, and introduced into the nonlinear structural equations, in order to obtain the transonic aerodynamic influence affecting the structural dynamics. Overall, an efficient method for computing fluid-flow-induced aeroelastic problems arises.
Author (AIAA)
Aeroelasticity; Inviscid Flow; Transonic Flow; Multigrid Methods; Unsteady Aerodynamics; Aerodynamic Loads

19980073017
Numerical simulation of the interaction between a leading-edge vortex and a flexible vertical tail
Morton, Scott A., USAF, Research Lab., USA; Rizzetta, Donald P., USAF, Research Lab., USA; Melville, Reid B., USAF, Research Lab., USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1957; Copyright; Avail: AIAA Dispatch

A subsonic flow field about a delta wing configuration is generated numerically in order to simulate the interaction between a leading-edge vortex and an elastic vertical tail. The computations are for a delta wing with a 70.0-deg sweep angle with twin vertical tails. Each tail has a leading edge sweep and structural modes similar to those of an F-15 fighter tail. Solutions are obtained on an overset zonal mesh system by time integration of the unsteady 3D compressible Euler equations. Details of the computations for the flexible tail are summarized, and the accuracy of numerical results is assessed via grid resolution and time step-size studies. The location of vortex breakdown for both rigid and elastic cases are computed at several values of freestream dynamic pressure to assess the importance of coupled fluid-structure interactions. Time histories of the tail motion are presented for variations in the structural model and dynamic pressure. In addition, a method of performing preliminary design parametric studies with a baseline nonlinear flow-field model is explored and found to be useful.
Author (AIAA)
Leading Edges; Interactional Aerodynamics; Vortices; Stabilizers (Fluid Dynamics); Dynamic Pressure

19980073173 NASA Langley Research Center, Hampton, VA USA
Spatial Characteristics of the Unsteady Differential Pressures on 16 percent F/A-18 Vertical Tails
Moses, Robert W., NASA Langley Research Center, USA; Ashley, Holt, Stanford Univ., USA; 1998; 11p; In English; 36th; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA/TM-1998-207323; NAS 1.15:207323; AIAA Paper 98-0519; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Buffeting is an aeroelastic phenomenon which plagues high performance aircraft at high angles of attack. For the F/A-18 at high angles of attack, vortices emanating from wing/fuselage leading edge extensions burst, immersing the vertical tails in their turbulent wake. The resulting buffeting of the vertical tails is a concern from fatigue and inspection points of view. Previous flight and wind-tunnel investigations to determine the buffet loads on the tail did not provide a complete description of the spatial characteristics of the unsteady differential pressures. Consequently, the unsteady differential pressures were considered to be fully correlated in the analyses of buffet and buffeting. The use of fully correlated pressures in estimating the generalized aerodynamic forces for the analysis of buffeting yielded responses that exceeded those measured in flight and in the wind tunnel. to learn more about the spatial characteristics of the unsteady differential pressures, an available 16%, sting-mounted, F-18 wind-tunnel model was modified and tested in the Transonic Dynamics Tunnel (TDT) at the NASA Langley Research Center as part of the ACROBAT (Actively Controlled Response of Buffet-Affected Tails) program. Surface pressures were measured at high angles of attack on flexible and rigid tails. Cross-correlation and cross-spectral analyses of the pressure time histories indicate that the unsteady differential pressures are not fully correlated. In fact, the unsteady differential pressure resemble a wave that travels along the tail. At constant angle of attack, the pressure correlation varies with flight speed.
Author
Aerodynamic Forces; Aeroelasticity; Angle of Attack; Buffeting; F-18 Aircraft; Leading Edges; Turbulent Wakes; Vortices

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19980048995 Centro de Instruccion de Medicina Aeroespatial, Madrid, Spain

Injury Prevention in Aircraft Crashes: Investigative Techniques and Applications: General Concepts and Objectives

RiosTejada, Francisco, Centro de Instruccion de Medicina Aeroespatial, Spain; Injury Prevention in Aircraft Crashes: Investigative Techniques and Applications; Feb. 1998; 8p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Accidents were investigated to reveal any of the wide range of human factors such as underlying illness, use of medications or drugs, fatigue, physical stresses, psychological and psychosocial stresses, types and extension of injuries received, causes of impact injuries, emergency escape from the aircraft, smoke and fire as related to survivability, environmental conditions and a number of other biomedical conditions that may have contributed to the crash or be related to occupant injury or survival. A detailed analysis of injury sustained in aircraft impact would contribute to an understanding of the mechanisms involved and to know the design limitations of the human body to an impact and its survivability. While many similar injuries can be inflicted in a variety of ways, there are certain characteristic findings which suggest likely mechanisms of injury. For example, compression fractures of vertebral bodies in the low thoracic and lumbar spine typically occur as a consequence of forces acting approximately parallel to the long axis of the spine.

Derived from text

Aircraft Accidents; Aircraft Accident Investigation; Human Factors Engineering; Injuries; Sicknesses; Survival; Prevention; Aircraft Safety

19980049179

Train, inspect, and audit - Is there any other way?

Carver, T., Civil Aviation Authority, UK; 1998, pp. 4.1-4.7; In English; Copyright; Avail: Aeroplus Dispatch

This paper considers changes in aviation safety and their impact and argues that, whereas external events may change our technology, the human resource which is still central to our industry remains constant in its failings. Air safety and commerce are considered as a combination in a total commitment of engineer, pilot, operator, and regulator, and it is shown that air safety can be maintained and enhanced mainly by concentrating on training, inspecting, and auditing. It is concluded that no single element of the aviation industry can abrogate or delegate to any other element all of its activities and responsibilities under any one of the three headings.

Author (AIAA)

Flight Safety; Air Transportation; Aircraft Safety; Management

19980049180

A global view of flight safety concerns

McInnis, R. J., International Federation of Air Line Pilots' Associations, UK; 1998, pp. 1.1-1.5; In English; Copyright; Avail: Aeroplus Dispatch

This paper examines the current safety concerns of the international pilot community and the trend for global airlines in the ever-increasing air traffic scenario. If the current increase in air traffic and its accident rate continues the industry could face a major accident every week in 10 years' time. Several areas of the world are recognized as being safety deficient; the reasons for these deficiencies are examined, together with graphic examples of accidents and incidents. An effective safety reporting system is called for one which can provide feedback without fear of prosecutions or job losses for those providing the reports. There still exists in some countries the situation where the agency that makes the rules not also enforces them but also investigates the accidents. This is in direct contravention of the ICAO guidelines. The paper ends with a practical solution on what can be done to provide positive answers to the problems.

Author (AIAA)

Flight Safety; Aircraft Accidents; Commercial Aircraft; Civil Aviation

19980049206

Thermal aspects of the atmospheric icing of airplanes ***Aspects thermiques du givrage atmospherique des aeronefs***

Guffond, Didier, ONERA, France; ONERA, TP no. 1997-80; 1997; In French

Report No.(s): ONERA, TP no. 1997-80; Copyright; Avail: Aeroplus Dispatch

The freezing of cloud water impacting on aircraft brings about important aerodynamic degradations. The freezing mechanism studied in modeling the means of deposition involves thermal processes which directly influence the pace of ice formation, and, therefore, on the induced degradations. On the other hand, certain protections against icing also equally involve thermal processes. This paper analyzes these different aspects from the phenomenological and modeling point of view. The protections are of two types: deicing, functioning cyclically and permitting the light deposit of ice, and anti-icing, generally thermal, which functions continuously and allows no deposit, whatsoever. The aircraft icing studies were done at ONERA. These icing wind tunnel tests allow for the development of reliable calculation codes.
AIAA
Aircraft Icing; Drops (Liquids)

19980049984

Flight safety - A total commitment; Proceedings of the Conference, London, UK, Feb. 3, 1998

1998; In English; ISBN 1-85768-019-7; Copyright; Avail: Aeroplus Dispatch

Various papers on flight safety are presented. The topics addressed are: a global view of flight safety concerns; type certification on new design concepts - SST (airworthiness requirements and new technology); service through safety - implications for flight crew training; training, inspecting, and auditing for flight safety; flight safety in business aviation; maintaining ATC safety levels while responding to the demands of increasing traffic; and investigation of accidents and incidents and lessons to be learned.
AIAA
Conferences; Flight Safety

19980049985

Type certification on new design concepts - SST (Airworthiness requirements and new technology)

Baker, P. P.; 1998, pp. 2.1-2.26; In English; Copyright; Avail: Aeroplus Dispatch

A discussion of some of the features of the slender delta design employed in the first supersonic airliner to be certified (the Concorde) is presented, with emphasis on some of those likely to require special attention to ensure a safety standard comparable with that of conventional airliners. Some of the requirements, with regard to landing, handling, the flight envelope, failure cases, and power plant, that evolved to ensure that that objective was achieved are examined. It is concluded that keeping up to date with aircraft development is an imperative for the Certification Authorities if they are not to lose credibility and if a comparable, if not improved, level of safety is to be maintained. In the case of the Concorde, this objective was achieved.
AIAA
Certification; Aircraft Design; Supersonic Transports; Aircraft Reliability; Technology Assessment

19980050117

Flight safety in business aviation

Robinson, John B.; 1998, pp. 5.1-5.6; In English; Copyright; Avail: Aeroplus Dispatch

Areas of business aviation where measures should be taken to improve air safety are addressed. Special attnetion is given to problems in flight operations which can in turn lead to safety problems. The role of pilot selection and training in business aviation is also discussed.
AIAA
Flight Safety; General Aviation Aircraft; Air Transportation; Civil Aviation

19980050118

The investigation of accidents and incidents and lessons to be learned

Whidborne, Richard StJ., Department of Transport, Air Accidents Investigation Branch, UK; 1998, pp. 7.1-7.14; In English; Copyright; Avail: Aeroplus Dispatch

The paper discusses the investigation of accidents and incidents from the perspective of a government investigation body. The attitudes of different parties towards a major occurrence, and their objectives, are discussed before describing some aspects of the methodology used in investigation. The lessons to be learned are described in terms of a ’product’ which comprises the identification of safety deficiencies and consequent recommendations. The closure of recommendations by recipients is discussed in terms of acceptance and implementation by the regulatory authorities.
Author (AIAA)
Aircraft Accident Investigation; Flight Safety; Civil Aviation; Methodology

19980050733

Maintaining existing ATC safety levels whilst responding to the demands of increasing traffic

Ennis, George, National Air Traffic Services, Ltd., UK; 1998, pp. 6.1-6.6; In English; Copyright; Avail: Aeroplus Dispatch

This paper explains how NATS plans to maintain or reduce the overall number of ATC induced safety incidents regardless of the rate of traffic growth. It summarizes the current air traffic situation in Europe and explains the NATS approach to managing safety. It highlights a current safety issue and illustrates how NATS is improving safety year-on-year, in particular how human factor issues are being addressed. The paper examines future ATC developments in terms of the technology and the new operating concepts needed to enhance capacity, safely and cost effectively, in line with growing demand.

Author (AIAA)

Air Traffic Control; Flight Safety; Air Traffic; Europe; Safety Management

19980051605

Totally committed

Price, Antonia; Aerospace International; Apr. 1998; ISSN 0305-0831; Volume 25, no. 4, pp. 16, 17; In English; Copyright; Avail: Aeroplus Dispatch

Barriers to flight safety include obvious procedural anomalies, confusing terminology, and airline industry changes that are faster than the ability of managers to accommodate safety criteria. Attention is here given to 'team resource management' and the more well-known 'crew resource management' approaches to flight safety enhancement.

AIAA

Flight Safety; Standards; Civil Aviation

19980054201

Daily aircraft routing and scheduling

Desaulniers, Guy, GERAD and Ecole Polytechnique de Montreal, Canada; Desrosiers, Jacques; Dumas, Yvan; Solomon, Marius M.; Soumis, Francois; Management Science; Jun, 1997; ISSN 0025-1909; Volume 43, no. 6, pp. 841-854; In English; Copyright; Avail: Issuing Activity

In this paper we consider the daily aircraft routing and scheduling problem (DARSP). It consists of determining daily schedules which maximize the anticipated profits derived from the aircraft of a heterogeneous fleet. This fleet must cover a set of operational flight legs with known departure time windows, durations and profits according to the aircraft type. We present two models for this problem: a Set Partitioning type formulation and a time constrained multicommodity network flow formulation. We describe the network structure of the subproblem when a column generation technique is applied to solve the linear relaxation of the first model and when a Dantzig-Wolfe decomposition approach is used to solve the linear relaxation of the second model. The linear relaxation of the first model provides upper bounds. Integer solutions to the overall problem are derived through branch-and-bound. By exploiting the equivalence between the two formulations, we propose various optimal branching strategies compatible with the column generation technique. Finally we report computational results obtained on data provided by two different airlines. These results show that significant profit improvement can be generated by solving the DARSP using our approach and that this can be obtained in a reasonable amount of CPU time.

Author (EI)

Scheduling; Mathematical Models; Problem Solving

19980055412

EURICE - An European effort for the improvement of in-flight aircraft icing safety

Amendola, A., Centro Italiano Ricerche Aerospaziali, Italy; Mingione, G., Centro Italiano Ricerche Aerospaziali, Italy; Caihol, D., Aerospatiale, France; Haul, T., DLR, Inst. fuer Physik der Atmosphaere, Germany; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0092; Copyright; Avail: Aeroplus Dispatch

The EURICE project (European Research on aircraft Icing Certification) is part of the European Community (EC) Fourth Framework Program that sets out the activities of the EC in the area of research and technological development in the years 1994 to 1998. In this paper the project structure and objectives, and finally the progress achieved thus far are presented. In particular the developed icing atmosphere data base and the icing incident data base are illustrated. The preliminary results from the research flights in icing conditions, including measurements of supercooled large droplets, are illustrated, and preliminary conclusions from a review of current regulations are discussed.

Author (AIAA)

Aircraft Icing; Aircraft Safety; In-Flight Monitoring

19980055413

Investigation into the effectiveness of certification and operational icing procedures for turboprops

Simpson, M. P., Loughborough Univ., UK; Render, P. M., Loughborough Univ., UK; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0093; Copyright; Avail: Aeroplus Dispatch

This paper presents information gathered from turboprop manufacturers and operators in Europe and Canada on the certification and operation of turboprop aircraft in icing conditions. It is recommended that: (1) ice protection methods be improved and that development costs be shared by a consortium of manufacturers, authorities, and research organizations; (2) the thermodynamic models used in the ice prediction codes be enhanced; (3) an ice prediction probe be developed which warns the aircrew that they will soon be entering icing conditions; (4) weather forecasts be made more accurate, reliable and descriptive as to how the aircraft will be affected by icing, and the installation of telemetry equipment on aircraft be considered to provide information for nowcast weather information; (5) improvements to pilot training be made by increasing the fidelity of the icing model on turboprop simulators; and (6) informative and motivating winter operations training be performed so that aircrews have a greater level of experience with icing conditions, ensuring that this is accessible to the smaller operators.

Author (AIAA)

Turboprop Aircraft; Aircraft Icing; Ice Prevention; Nowcasting; Pilot Training

19980055414

A workable, aircraft-specific icing severity scheme

Jeck, R., FAA, Technical Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0094; Copyright; Avail: Aeroplus Dispatch

This paper explores the idea of defining icing intensities (trace, light, moderate, and severe) quantitatively in terms of the time required for a specific depth (say 1/4 inch (6 mm)) of ice to accumulate on an individual airfoil during exposure to icing conditions. For example, trace icing could correspond to conditions where 60 minutes or more is required to accumulate 1/4 inch on the leading edge of any particular wing or tailplane. Light, moderate, and severe icing could mean that 15-60 minutes, 5-15 minutes, and less than 5 minutes, respectively, are required to accumulate 1/4 inch. Available, computerized ice accretion models (such as LEWICE) can then be used to easily determine how much time is required for 1/4 inch of ice to accrete on the leading edge of an airfoil during exposure to a given liquid water concentration (LWC), median volume dropsize diameter (MVD), and outside air temperature (OAT) at a given airspeed, altitude, and angle of attack. In this way the icing intensity for a given airfoil in a given icing condition is unambiguous, readily calculable, and measurable. This scheme offers a universal rule which is applicable to all airplanes while providing a simple but meaningful way to account for the individual sensitivities of different aircraft. Example results are shown for computed icing intensities on a dozen real airplanes of all sizes. The potential benefits for icing forecasts, pilot icing reports (PIREPS), and for documenting icing flight test conditions are pointed out.

Author (AIAA)

Aircraft Icing; Airfoil Profiles; Time Dependence; Leading Edges; Atmospheric Temperature

19980055415

An interdisciplinary approach to inflight aircraft icing safety

Bragg, Michael B., Illinois, Univ., Urbana, USA; Perkins, William R., Illinois, Univ., Urbana; Sarter, Nadine B., Illinois, Univ., Urbana; Basar, Tamer, Illinois, Univ., Urbana; Voulgaris, Petros G., Illinois, Univ., Urbana; Gurbacki, Holly M., Illinois, Univ., Urbana; Melody, James W., Illinois, Univ., Urbana; McCray, Scott A., Illinois, Univ., Urbana; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0095; Copyright; Avail: Aeroplus Dispatch

Aircraft accidents in icing conditions are primarily the results of the degradation in performance and control due to the aerodynamic effects of the ice. However, despite recent advances in the ability to identify these changes, the icing sensors currently in use sense only ice thickness or accretion rate at the sensor location. No aircraft performance degradation information is available to the pilot. In this paper, a smart icing system is proposed based on the ability to sense the effect of ice on the aircraft performance, stability and control. This concept is proposed through the addition of an Ice Management System to the aircraft. This system would add an additional level of safety to supplement the current avoidance and ice protection concepts currently in use. Such a system would sense ice accretion through traditional icing sensors and use modem system identification methods to estimate aircraft performance and control changes. This information would be used to automatically operate ice protection systems, provide aircraft envelope protection and, if icing was severe, adapt the flight controls. All of this must be properly communicated to and coordinated with the flight crew. The design of such a system requires a coordinated interdisciplinary approach. In addition

to describing the basic concept, this paper reviews the research needed in three critical areas; aerodynamics and flight mechanics, aircraft controls, and human factors.
Author (AIAA)
Aircraft Icing; In-Flight Monitoring; Aircraft Safety; Aerodynamic Characteristics; Smart Structures; Aircraft Control

19980055446
Building the future aircraft design for the next century
Szrodruch, Joachim, Daimler Benz AG, Germany; Hilbig, Reinhard., Daimler Benz AG, Germany; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0135; Copyright; Avail: Aeroplus Dispatch

Competition in the global transport aircraft market forces airlines to reduce costs; this in turn requires from the aircraft manufacturer a reduction in development time and costs. On the other hand, it is important to note that aircraft complexity, quality and certification requirements are steadily increasing. Furthermore, performance guarantees given to the customers are getting more and more stringent. Within this environment, it is extremely important to prepare to build for a future in aircraft design in general and aerodynamics specifically, which is competitive, robust and in the end commercially successful. Based on recent technical achievements in aircraft design and operation, the present paper describes general customer views and expectations, and the aircraft design process, looking specifically at the role of aerodynamics. The challenges of the future are dictated by market forces and legislation, and have an impact on the technologies, the design, and the cooperation among the parties involved in research, in aircraft development, manufacturing and operation.
Author (AIAA)
Aircraft Design; Aircraft Production; Aerospace Industry; Product Development

19980055731
Droplet size distribution and ice shapes
Shah, Anil D., Boeing Co., USA; Patnoe, Michael W., Boeing Co., USA; Berg, Ervin L., Boeing Co., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0487; Copyright; Avail: Aeroplus Dispatch

The impingement characteristics and ice shapes on a wing airfoil have been analyzed using the LEWICE computer code with actual drop size distributions (DSDs). The actual mass distribution was grouped in a manner similar to a Langmuir distribution for this analysis. The ice shapes, total collection efficiencies, and the extent of area coverage on the wing airfoil section computed from the modified-Langmuir distribution and the Langmuir 'A' and 'D' distributions were compared. DSD of supercooled large droplet (SLD) conditions appear to produce a secondary ice shape behind the primary ice accretion shape on the leading edge of the airfoil. Preliminary results with regard to the use of median volume diameter, i.e., the diameter such that half of the liquid water content is in droplets of larger diameter and the other half in droplets of smaller diameter, with SLD icing are also presented. Knowledge of the DSD is essential to establish the impingement characteristics. It was also concluded that there is a need for more quality DSD measurements in the icing clouds and in freezing drizzle conditions.
Author (AIAA)
Size Distribution; Aircraft Icing; Drop Size; Shapes; Supercooling

19980055734
An experimental and computational investigation of spanwise-step-ice shapes on airfoil aerodynamics
Lee, Sam, Illinois, Univ., Urbana, USA; Dunn, Tim, Illinois, Univ., Urbana; Gurbacki, Holly, Illinois, Univ., Urbana; Bragg, Mike, Illinois, Univ., Urbana; Loth, Eric, Illinois, Univ., Urbana; Jan. 1998; In English
Contract(s)/Grant(s): DTFA-MB96-6-023
Report No.(s): AIAA Paper 98-0490; Copyright; Avail: Aeroplus Dispatch

The effects of spanwise-step-ice accretions (resulting from large droplet icing conditions) on subsonic aircraft aerodynamics are studied. The airfoil investigated was a modified NACA 23012 with a simple flap. An experimental and computational program was conducted using simulated ice accretions to determine the sensitivity of ice shape size and location on airfoil performance and control as a function of angle of attack and flap deflection. The focus is on the critical conditions where the aerodynamic performance, and the hinge moment in particular, changes rapidly and nonlinearly. The experimental program included wake surveys, surface pressure taps, and force-balance measurements to obtain lift, drag, pitching moment, and hinge-moment coefficients for a large variety of geometry and flow conditions. The accompanying computational investigation was performed with a high-resolution full Navier-Stokes solution using a solution-adaptive unstructured grid for both noniced and iced configurations. Results are presented for experiments and predictions of sectional aerodynamic characteristics where the quarter-round ice shape heights

of 0.0083 and 0.0139 chords resulted in a dramatic decrease in maximum lift coefficients, as well as significant reductions in hinge moments for positive angles of attack.
Author (AIAA)
Airfoils; Shapes; Aircraft Icing; Aerodynamic Characteristics; Subsonic Aircraft

19980055746

Reconstruction of the 1994 Pittsburgh airplane accident using a computer simulation

Parks, Edwin K., Arizona, Univ., Tucson, USA; Shin, Jae H., Arizona, Univ., Tucson; Bach, Ralph E., Jr., NASA Ames Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NCC2-329
Report No.(s): AIAA Paper 98-0503; Copyright; Avail: Aeroplus Dispatch

On September 8, 1994, a Boeing 737-300 passenger airplane was on a downwind approach to Pittsburgh International at an altitude of 5000 feet. While in a shallow left turn onto a downwind approach heading, the airplane crossed into the vortex trail of a Boeing 727 flying in the same approach pattern about 4 miles ahead. The B-737 airplane rolled and turned sharply to the left, exited the vortex wake, and plunged into the ground. Weather was not a factor in the accident. The aircraft was equipped with a 11+ channel digital Flight Data Recorder (FDR) and a multiple channel Cockpit Voice Recorder. Both recorders were recovered from the crash site and provided excellent data for the development of an accident scenario. Radar tracking of the two airplanes as well as the indicated air speed perturbations clearly visible on the B-737 FDR recordings indicate that the upset was apparently initiated by the airplane's crossing into the wake of the B-727 flying ahead in the same traffic pattern. A six-degree-of-freedom simulation program for the B-737 airplane using MATLAB and SIMULINK was constructed. The simulation was initialized at the stabilized flight conditions of the airplane about 13 seconds prior to its entry into the vortex trail of the B-727 airplane. by assuming a certain combination of control inputs, it was possible to produce a simulated motion that closely matched that recorded on the FDR.
Author (AIAA)
Aircraft Accidents; Computerized Simulation; Boeing 737 Aircraft

19980055747

Helicopter flight simulation after rotor blade failure for accident investigation

Mello, Olympio A. F., Centro Tecnico Aeroespacial, Brazil; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0504; Copyright; Avail: Aeroplus Dispatch

After a helicopter accident at sea in which the aircraft had not been recovered, the investigation board had to rely on information from the Flight Data Recorder (FDR), Cockpit Voice Recorder and a video recorded by an underwater robot. The most significant information obtained from the FDR were extremely high vibrations in all three axes, most notably a +/- 1 g longitudinal vibration. The frequency of these vibrations was found to be associated with the first harmonic of main rotor rotational speed. The investigation was then directed towards several main rotor blade failure hypotheses that might explain the vibrations. In order to provide a consistent basis for determination of the most probable cause, a simulation program based on an existing general helicopter flight simulation code was developed. Simulations were conducted for the assumed blade failure hypotheses. Simulated accelerations indicated that the excessive accelerations were consistent with the loss of a large rotating mass, either due to total blade loss or blade fracture near the root. Therefore, the simulation provided substantial grounds for the investigation board to establish these hypotheses as the most probable causes.
Author (AIAA)
Flight Simulation; Rotor Blades; System Failures; Aircraft Accidents; Helicopters; Flight Recorders

19980055807

Icing analysis, flight test and certification of the Gulfstream GV business jet

Olsen, Paul, Gulfstream Aerospace Corp., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0571; Copyright; Avail: Aeroplus Dispatch

In one of the most extensive applications to date of the NASA/Lewis ice accretion code LEW13DGR, certification of the Gulfstream GV ultralong range business jet was obtained under FAR 25.1419. Analyses were performed to model water droplet impingement on lifting and nonlifting surfaces, including those both protected and unprotected from accretion. Heat transfer rates for treating leading edges were determined from dry air flight testing. Ice shapes were calculated and fabricated for artificial ice shape testing. Flight tests were conducted with artificial shapes to verify aircraft performance with heavy ice accretion. The recently required zero-g horizontal stall pushover maneuver was flown. Flight into known icing natural ice tests were conducted

to reaffirm aircraft performance and validate the ice protection system design. All testing was completed successfully, and certification was obtained. A list of lessons learned to streamline future icing certification was compiled.
Author (AIAA)
Jet Aircraft; Aircraft Icing; Flight Tests; Jet Impingement; Aerodynamic Heat Transfer; Deicing

19980055809

Aerodynamic acceptance test for commuter aircraft de-icing and anti-icing fluids

Louchez, Patrick R., Quebec, Univ., Canada; Bernardin, Sylvie, Quebec, Univ., Canada; Perron, Eric, Quebec, Univ., Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0574; Copyright; Avail: Aeroplus Dispatch

This work describes the modified procedure which enables standard evaluation of anti-icing fluids for commuter aircraft and an assessment of experimental anti-icing fluids for commuter aircraft (Type III fluids). The testing method, similar to that for large aircraft, determines the boundary layer displacement thickness (BLDT) induced by a film of anti-icing fluid, applied on a flat horizontal plate and subjected to a linear acceleration of 2.1 m/sq s, during 16.5 s, up to 35 m/s. The method is shown to be repeatable and accurate. Flat plate results are shown to correlate well with a 2D model study performed at NASA/Lewis by Boeing Canada de-Havilland Division. According to this correlation, the maximum acceptable BLDT value, for aircraft with a rotation velocity between 60 and 100 KT, was found to be 10.6 mm. One experimental fluid was found to be acceptable down to about -25 C. Other fluids are also acceptable in a limited temperature range. No Type II fluid, in this study, was found acceptable for commuter aircraft.
Author (AIAA)
Aircraft Icing; Deicing; Antiicing Additives; Aerodynamic Characteristics; Wing Profiles; Commuter Aircraft

19980055812

NASA/FAA/NCAR supercooled large droplet icing flight research - Summary of winter 96-97 flight operations

Miller, Dean, NASA Lewis Research Center, USA; Bernstein, Ben, NCAR, USA; McDonough, Ben, NCAR, USA; Strapp, J. W., Atmospheric Environment Service, Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0577; Copyright; Avail: Aeroplus Dispatch

During the winter of 1996-1997, a flight research program was conducted at NASA/Lewis to study the characteristics of supercooled large droplets (SLDs) within the Great Lakes region. Onboard instrumentation was used to record meteorological, ice accretion, and aero-performance characteristics encountered during the flight. A total of 29 icing research flights were conducted, during which ’conventional’ small droplet icing SLDs, and mixed phase conditions were encountered aloft. This paper describes how flight operations were conducted, provides an operational summary of the flights, presents selected experimental results from one typical research flight, and concludes with practical ’lessons learned’ from this first year of operations.
Author (AIAA)
Aircraft Icing; NASA Programs; Flight Conditions; Supercooling; Research Facilities

19980055813

Aircraft icing remote sensing

Ryerson, Charles C., U.S. Army, Cold Regions Research and Engineering Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0578; Copyright; Avail: Aeroplus Dispatch

Current icing forecasts are not sufficiently detailed to allow efficient avoidance. A safer and more accurate method of avoiding icing may be to detect icing potential ahead of aircraft using remote sensors to provide location and intensity information. NASA-Lewis, the FAA Technical Center, and the U.S. Army Cold Regions Research and Engineering Laboratory are accelerating development of systems for remotely detecting icing conditions in the flight path. As a result, a workshop on the topic has been held, and work on the problem is being conducted internally and under contract by each agency. This paper reviews current knowledge about the needs and requirements of aircraft icing remote sensing systems from operational, meteorological, and technological perspectives. Work conducted to date and a government research plan to accelerate technology development are described.
Author (AIAA)
Aircraft Icing; Remote Sensing; Flight Conditions; Aviation Meteorology; Technology Assessment

19980055823

The NASA-Langley wake vortex modelling effort in support of an operational aircraft spacing system

Proctor, Fred H., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0589; Copyright; Avail: Aeroplus Dispatch

Two numerical modelling efforts, one using a large eddy simulation model and the other a numerical weather prediction model, are underway in support of NASA's Terminal Area Productivity program. The large-eddy simulation model (LES) has a meteorological framework and permits the interaction of wake vortices with environments characterized by crosswind shear, stratification, humidity, and atmospheric turbulence. Results from the numerical simulations are being used to assist in the development of algorithms for an operational wake-vortex aircraft spacing system. A mesoscale weather forecast model is being adapted for providing operational forecast of winds, temperature, and turbulence parameters to be used in the terminal area. This paper describes the goals and modeling approach, as well as achievements obtained to date. Simulation results are presented from the LES model for both 2D and 3D. The 2D model is found to be generally valid for studying wake vortex transport, while the 3D approach is necessary for realistic treatment of decay via interaction of wake vortices and atmospheric boundary layer turbulence. Wake vortex transport is unaffected by uniform fog or rain, but wake vortex transport can be strongly affected by nonlinear vertical change in the ambient crosswind. Vortex decay and the onset of 3D instabilities are found to be enhanced by the presence of ambient turbulence.
Author (AIAA)
Large Eddy Simulation; Numerical Weather Forecasting; Aircraft Approach Spacing; NASA Programs; Vortices; Mesometeorology; Aircraft Wakes

19980055882

Development and validation of a wake vortex predictor algorithm

Robins, Robert E., Northwest Research Associates, Inc., USA; Delisi, Donald P., Northwest Research Associates, Inc., USA; Greene, George C., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0665; Copyright; Avail: Aeroplus Dispatch

The algorithm described herein predicts the trajectories and circulation decay of aircraft trailing vortices. We first present the methodology used by the algorithm to simulate trailing vortex behavior, including (1) the descent of the vortices through a realistic atmosphere defined by stratification, turbulence, and cross wind profiles, and (2) the interaction of the vortices with the ground. Both the increase in separation between the vortices caused by their approaching the ground and the generation of secondary vorticity due to their interaction with the ground are modeled by the algorithm. We then compare algorithm results with field data and discuss the algorithm's validity and sensitivity. We show that the algorithm performs reasonably well for vortices out of ground effect, and produces promising results for vortices in ground effect. Since it runs in less than one-tenth of a second on a state-of-the-art workstation, the algorithm is suitable for use in a real-time aircraft vortex separation system.
Author (AIAA)
Trailing Edges; Vortices; Aircraft Wakes; Atmospheric Turbulence

19980055884

A method for accelerating the destruction of aircraft wake vortices

Rennich, Steven C., Stanford Univ., USA; Lele, Sanjiva K., Stanford Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0667; Copyright; Avail: Aeroplus Dispatch

The wake vortices shed by large aircraft and their associated hazard to following aircraft remain an important issue in commercial aviation. In this paper we present results from numerical simulations detailing a potentially useful mechanism for accelerating the destruction of the aircraft vortex wake and reducing the wake vortex hazard. We use 'destruction' to refer to the progressive annihilation of the wake due to mixing of vorticity of the opposite sign and the associated elimination of large coherent structures. Our emphasis here is on a description of the mechanism and its connection to previous work.
Author (AIAA)
Aircraft Wakes; Vortex Shedding; Vortex Breakdown; Flow Visualization; Vortex Filaments

19980055958

Investigation into the effectiveness of certification and operational icing procedures for helicopters

Simpson, M. P., Loughborough Univ. of Technology, UK; Render, P. M., Loughborough Univ. of Technology, UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0750; Copyright; Avail: Aeroplus Dispatch

This paper presents information gathered from helicopter airframe and engine manufacturers, as well as operators, both in Europe and Canada. It details the measures taken to prevent accidents in icing conditions through helicopter design and operating procedures. The major conclusions of the paper are that a helicopter's operating procedures change, depending on whether the route is off-shore or overland. When flying over water, there is normally a positive temperature layer above the sea, which can be used as an escape route by helicopters that encounter icing conditions. The principal types of icing that affect helicopters are

engine icing and main rotor icing. Ice accretion is a gradual process, which the pilot should be able to detect from visual cues, instrument levels and handling changes. Most helicopters are not cleared for flying in any icing conditions, although nearly all their engines have basic forms of ice protection. The methods used to certify helicopters have been adapted from those of fixed wing aircraft, so the applicability of the airworthiness requirements should be validated for helicopter operations.
Author (AIAA)
Aircraft Icing; Helicopter Engines; Airframes; Ice Prevention; Helicopter Performance; Flight Crews

19980056662

Airlines opt for EGPWS installation fleet-wide

McKenna, James T., USA; Aviation Week & Space Technology; Dec. 22, 1997; ISSN 0005-2175; Volume 147, no, nos. 25-26, pp. 8, 9; In English; Copyright; Avail: Aeroplus Dispatch

The airlines constituting the Air Transport association have committed themselves to the installation of the Enhanced Ground Proximity Warning System (EGPWS) by the year 2003; the total number of aircraft to be thus equipped is projected to be 4500. EGPWS addresses the globally severe safety problem of controlled flight into terrain by airliners on landing approaches.
AIAA
Turbine Engines; Air Transportation; Lockheed Aircraft

19980056665

Airbus - Automated transports safer than older aircraft

Sparaco, Pierre, France; Aviation Week & Space Technology; Jan. 05, 1998; ISSN 0005-2175; Volume 14, no. 1, pp. 40, 41; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of current controversies concerning the Airbus Industrie (AI) claim that new, highly automated airliners are enhancing flight safety; European pilots often believe that safety record improvements are due to a more complex confluence of factors. AI further claims that overall accident rates would be reduced by retiring first- and second-generation aircraft, as is expected to occur in keeping with environmental regulations.
AIAA
European Airbus; Aircraft Safety; Aircraft Pilots; Human Factors Engineering; Transport Aircraft

19980056767

Transportation-communications relationships in industry

Plaut, Pnina O., Technion - Israel Inst. of Technology, Israel; Transportation Research, Part A: Policy and Practice; Nov, 1997; ISSN 0965-8564; Volume 31, no. 6, pp. 419-429; In English; Copyright; Avail: Issuing Activity

Relationships between transportation and communications have generally been analyzed at the household level. Yet most transportation and communications services are used by industry. This paper examines the relationship between uses of transportation and communications services by industry in the countries of the European Community. It is shown that a clear pattern of complementarily appears to hold for such industrial uses throughout Western Europe. The complementarily appears to hold for all subsectors of the transportation service industry.
Author (EI)
Regional Planning; Transportation; Telecommunication; Economics

19980058018

20,000-hour tuneup

Hoffman, Carl, USA; Air & Space; Nov. 1997; ISSN 0886-2257; Volume 12, no. 4, pp. 38-45; In English; Copyright; Avail: Aeroplus Dispatch

The aircraft maintenance schedules and procedures, as practiced by the major airline operators, are described in a popular manner and illustrated by examples. The procedures range from replacing so-called hard-time items, such as engines, flaps, fuel pumps, and landing gear, all of which are changed after a set number of hours or takeoff-and-landing cycles, to ever deeper and more thorough inspections and maintenance of airframe itself. As an airline gains experience operating its fleet, it develops its own schedule for maintaining the aircraft. In addition, FAA Airworthiness Directives often require new maintenance and modifications not originally called for by the initial Maintenance Review Board.
AIAA
Aircraft Maintenance; Corrosion; Fracture Mechanics

19980059228

History of the Terminal Area Surveillance System (TASS)

Rogers, James W., FAA, USA; Buckler, Lewis, FAA, USA; Harris, Angela C., FAA, USA; Keehan, Mark, FAA, USA; Tidwell, Cam J., Jr., FAA, USA; Little, Arthur D., FAA, USA; 1997, pp. 157, 158; In English; Copyright; Avail: Aeroplus Dispatch

The FAA's TASS R&D program was established in 1990 for the development of a multifunctional radar capable of meeting the requirements of both weather and aircraft surveillance. The project was terminated whan a major sponsor, the USAF, chose to acquire an already-operational system.

AIAA

Surveillance Radar; Radar Tracking

19980060311

An integrated safety-analysis methodology for emerging air-transport technologies

Allinger, Deborah F., Charles Stark Draper Lab., Inc., USA; Rosch, Gene, Charles Stark Draper Lab., Inc., USA; Kuchar, James K., MIT, USA; 1998, pp. 260-267; In English; Copyright; Avail: Aeroplus Dispatch

We demonstrate an approach to integrating reliability, performance, and operational procedures modeling into a system safety analysis. Our methodology is distinguished by its ability to merge system design information with the dynamic parameterization of a system's situation in order to measure accident statistics and reliable system operation. As an application of this methodology, we have considered the problem of simultaneous, but independent approaches of two aircraft on closely-spaced parallel runways, Independent Approaches on Parallel Runways, or IAPR. The IAPR concept presumes a flight-deck-based navigation, communication, surveillance, and alerting system. The potential exists for an aircraft on either runway to deviate off course toward another aircraft on the parallel runway. A variety of simulation projects have been undertaken within the last several years to explore alerting systems for the parallel approach situation, but the major limitation of statistical information generated from these studies is that it represents conditional safety statistics given the flight track simulated. to remove this conditioning, we have shown how to apply the probability of flying the approach with a given flight track using Markov analysis to compute this probability. The results show how each of the probabilities of reliable operation, accidents, and false alarms vary as a function of runway spacing.

Author (AIAA)

Air Transportation; Systems Integration; Aircraft Reliability; Flight Safety; Markov Processes

19980060351

Impact of maintenance staffing on availability of the U.S. Air Traffic Control System

Hecht, Myron, SoHaR, Inc., USA; Handal, Jady, FAA, USA; Czekalski, Loni, FAA, USA; Rosin, Abraham, System Resources Corp., USA; 1998, pp. 113-119; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a model for assessing the impact of staffing on outage times and availability in the national network of air traffic control equipment using a finite queuing model. Because of the wide geographic distribution of FAA facilities and equipment, maintenance is provided out of a national network of cost centers. Each such center has a limited number of technicians ('servers') who are responsible for providing scheduled maintenance and repair for the equipment assigned to that center. When an equipment requires service and a qualified technician is available, then the outage time is simply the repair time. However, if there are equipment failures when technicians are busy making other repairs, then there is an additional waiting time until a qualified technician is free. The model determines average outage times as a function of the number of technicians assigned to a cost center, equipment failure rates, and the number of equipment which technicians must support. Results for a representative cost center are that the average maintenance technician utilization and the average outage duration was approximately 26 h. Typically close to 4000 systems await repair due to outages at any given time. More than 80 percent of the outage time is attributable to awaiting a repair technician.

Author (AIAA)

Air Traffic Control; Cost Estimates; Control Equipment; Maintenance; Air Traffic Controllers (Personnel)

19980060898

Protect and survive

Hardwick, John, AEA Technology plc, UK; Aircraft Engineering and Aerospace Technology; 1997; ISSN 0002-2667; Volume 69, no. 5, pp. 428-431; In English; Copyright; Avail: Issuing Activity

Lightning strikes are potentially dangerous so aircraft manufacturers work hard to design effective protection. Explains how LTT's expertise ensures that manufacturers' protection systems are reliable.
Author (EI)
Flight Hazards; Lightning; Protection

19980062348

Dassault Electronique enters advanced GPWS market

Proctor, Paul, USA; Aviation Week & Space Technology; Jan. 26, 1998; ISSN 0005-2175; Volume 14, no. 4, pp. 51, 52; In English; Copyright; Avail: Aeroplus Dispatch

Dassault Electronique and Teledyne Controls are in certification flight tests of ground collision avoidance systems (GCAS) to compete with AlliedSignal's enhanced ground proximity warning systems (GPWS). Teledyne is teaming with Dassault to help market, support, and repair GCAS, primarily in the Americas, with Dassault retaining marketing and support responsibilities for the remaining 50 percent of the globe. GCAS is planned as a minimal pilot workload, near plug-and-play replacement of the existing GPWS.
AIAA
Aircraft Industry; Flight Safety; Collision Avoidance

19980062353

User concerns focus on congestion, policy

Ott, James, USA; Aviation Week & Space Technology; Feb. 02, 1998; ISSN 0005-2175; Volume 14, no. 5, pp. 48-50; In English; Copyright; Avail: Aeroplus Dispatch

Users' concerns about the U.S. air traffic control system and the need for ATC modernization are examined. The current complaints relate to system congestion and mounting relays and reliability issues. The users surveyed are divided or confused about FAA policy shifts towards acquisitions, contracts, and spending. Most users agree that the FAA needs a reliable funding stream.
AIAA
Air Traffic Control; Policies

19980062401

Spin chutes - Y'all be careful

Newton, Dennis, USA; Cockpit; Dec. 1997; ISSN 0742-1508, pp. 12-16; In English; Copyright; Avail: Aeroplus Dispatch

Some instances of accidents over the past 25 years that are directly attributable to or involving malfunctions of spin check systems are presented. In view of the past experience, it is suggested that test pilots must be able to ask the right questions in order to assure the selection of an adequate system when one is needed. Some general considerations that can be applied to the selection of a spin check system are then summarized.
AIAA
Aircraft Control; Recovery Parachutes; Aircraft Spin; Spin Stabilization

19980062813

This orange 'black box' ***Ehtot oranzhevyj 'chernyj yashchik'***

Suvorova, T., Russia; Grazhdanskaya Aviatsiya; May 1997; ISSN 0017-3606, no. 5, pp. 42, 43; In Russian; Copyright; Avail: Aeroplus Dispatch

The issue of flight safety and measures that are currently taken in Russia in order to improve the safety of airline operations are briefly reviewed. In particular, the activities of the State Center for Flight Safety are discussed with emphasis on methods used in investigating flight accidents. The role of the Center in preventing future accidents is also examined
AIAA
Flight Safety; Airline Operations; Flight Recorders; Aircraft Accident Investigation

19980062870

Large excrescences on transport aircraft: a cautionary tale

Greenwell, D. I., Defence Evaluation and Research Agency, UK; Cement & Concrete Composites; Apr, 1997; ISSN 0958-9465; Volume 19, no. 2, pp. 327-330; In English; Copyright; Avail: Issuing Activity

This note describes an installation which was extensively tested in a large-scale commercial windtunnel and was found to give apparently well-behaved steady-state aerodynamic characteristics but which, when flight tested, exhibited unacceptable levels of airframe buffeting and rather unusual directional stability problems. A reexamination of the fuselage flowfield using a sim-

plified model, but with attention focused on the unsteady aspects of the flow, rapidly identified the underlying cause and enabled a successful aerodynamic fix to be developed. The lessons learnt from this experience are presented as a warning to those contemplating the addition of large excrescences to any airframe.
Author (revised by EI)
Flight Tests; Transport Aircraft; Fuselages; Wind Tunnels; Flow Visualization; Stability

19980063060

European aviation companies face to face with deregulation - Stakes and prospects ***Les compagnies aeriennes europeennes face a la dereglementation - Enjeux et perspectives***

Saissi, Olivier P., Nice-Sophia Antipolis, Univ., France; Nouvelle Revue d'Aeronautique et d'Astronautique; Dec. 1997; ISSN 1247-5793, no. 6, pp. 29-34; In French; Copyright; Avail: Aeroplus Dispatch

New strategic polices for confronting deregulation are discussed. These include: (1) organizational restructuring including the creation of a dynamic architecture and (2) a holistic alliance process. These two features can allow European companies to adapt to deregulation, but they will not be the final steps of the process. It is concluded that each company needs to create a continuous dynamic adaptation process in order to ensure its continued existence.
AIAA
Air Transportation; Air Law

19980064864

Low direct operating cost transPacific commercial transport family

Swihart, John M., Swihart Consulting, USA; Brown, Robert B.; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1070; Copyright; Avail: Aeroplus Dispatch

This paper presents a complete family of airplanes evolving from one basic body cross section ranging from 150 to over 600 passengers. Pacific travel will change from hub-to-hub operations to point-to-point operations, just as Atlantic travel has changed, when this family of low cost, ultrarange airplanes becomes available. Near term capability for this family of airplanes is possible between 40 North American cities and over 30 Asiatic destinations. The combination of innovative simplicity and total family commonality can lower direct operating costs by 25 percent or more and permit total market coverage in the 150 to 600 plus seat sizes. This papers details the attractive features of this airplane family, which include low ticket price, nonstop high speed flight (M = 0.88 cruise) for 9000 n. mi range, doubles only seating, 100 percent fresh air to each passenger combined with a cabin altitude of only 4000 feet, ample accessible overhead stowage, dispatch reliability and flight safety excellence, and common pilot, cabin crew, and aircraft mechanic type ratings. Innovative simplicity solutions result in a 50 percent cost reduction of most structural elements and systems, including engine systems. Aerodynamic and weight efficiency, reliability, maintenance, and flight safety improvements are synergistic with the low cost in the innovative solutions shown in this paper.
Author (AIAA)
Cost Analysis; Transport Aircraft; Commercial Aircraft; Transoceanic Flight; Pilot Performance

19980065402

Regulating European safety

Probst, Claude, EC, France; Aerospace International; Feb. 1998; ISSN 0305-0831; Volume 25, no. 2, pp. 28-31; In English; Copyright; Avail: Aeroplus Dispatch

The role of the European Union in ensuring aviation safety is examined. In particular, attention is given to the regulatory issues relating to aviation safety and the questions of the application and interpretation of rules. The future of the Joint Aviation Authorities (JAA) is also briefly discussed.
AIAA
Aerospace Safety; Regulations; Europe

19980065450

What happened to Flight 800

Tischler, Adelbert O., USA; Aerospace America; Mar. 1998; ISSN 0740-722X; Volume 36, no. 3, pp. 30-34; In English; Copyright; Avail: Aeroplus Dispatch

On the basis of well-established data, the present survey of the current understanding of the midair destruction of Flight 800 on July 17, 1996 develops plausible concepts. A detailed examination is conducted of the 747 center fuel tank and fuel pump systems, which have been the focus of conjecture.
AIAA
Boeing 747 Aircraft; Aircraft Accident Investigation; Midair Collisions; Flight Safety; Fuel Systems

19980067160
Recording aircraft accident data; Proceedings of the Conference, London, UK, Oct. 20, 21, 1997
1997; In English; ISBN 1-85768-004-9; Copyright; Avail: Aeroplus Dispatch

Various papers on the recording of aircraft accident data are presented. Individual topics addressed are: flight recorders, evolution of flight recorder media and protection techniques, combined CVR and FDR, recovering data from nonvolatile memories, analyzing accident data, development of new standards and recommended practices, requirement development, fire and crash protection, data analysis with advanced graphics, and managing systems.
AIAA
Transport Aircraft; Aircraft Accident Investigation; Flight Recorders; Data Recorders

19980067164
Recovering data from non-volatile memories
Bastianelli, Jerome, Bureau Enquetes-Accidents, France; Giraud, Franck, Bureau Enquetes-Accidents, France; 1997, pp. 6.1-6.10; In English; Copyright; Avail: Aeroplus Dispatch

In the context of aircraft accident investigation, the recorders required by law are the flight data recorder and the cockpit voice recorder. Even though these recorders store a large amount of information, they cannot cover every event completely. Aircraft also carry other types of equipment to record data, known as NVMs, a term which covers everything from the GPS found in general aviation to jumbo jet computers. Though their main aim is not related to accident investigation they can, in some cases, provide vital data. After a general presentation of this investigatory technique, a concrete example shows both the wide scope and the limitations of these memories in this context.
Author (AIAA)
Aircraft Accident Investigation; Flight Recorders; Data Recorders; Cockpits; Voice Data Processing; Memory (Computers)

19980067165
Analysing accident data - Are the systems meeting the need?
Sheppard, Peter F., DETR, Air Accident Investigation Branch, UK; 1997, pp. 7.1-7.5; In English; Copyright; Avail: Aeroplus Dispatch

This paper attempts to go through the stages of extracting, converting, and analyzing information from accident-protected recorders after an accident has occurred. It attempts to show where the problems have been and why some recorders have not functioned as expected. Losses have occurred due to recorders not surviving accidents or due to failures before the event. A few suggestions are made as to what might be needed in the future, such as video recording or a sudden event detector.
Author (AIAA)
Aircraft Accident Investigation; Aircraft Survivability; Flight Recorders; Aircraft Reliability

19980067166
International Civil Aviation Organisation Flight Recorder Panel (FLIRECP) - Development of new standards and recommended practices
Mayes, Paul, Bureau of Air Safety Investigation, Australia; 1997, pp. 9.1-9.28; In English; Copyright; Avail: Aeroplus Dispatch

The International Civil Aviation Organisation's (ICAO) Standards and Recommended Practices for flight recording and the carriage of flight recorders are contained in Annex 6 and Annex 13. Annex 13 specifically deals with accident investigation and in 1992 ICAO held a major divisional meeting in Montreal to discuss numerous issues dealing with accident investigation. The meeting agreed to the formation of a panel (FLIRECP) of experts to deal with the flight recording matters which had been raised and to conduct a full review of the ICAO Standards and Recommended Practices. The panel began by reviewing the current ICAO regulations and comparing them with the current national regulations. Since the last update of the flight recorder Annexes, there had been several important technological advances in aircraft design and systems, and in flight recording technology, and the panel reviewed the impact of these advances. Specific issues which were considered in detail included video recording and data link communications associated with CNS/ATM (FANS). The panel developed 30 recommendations for changes to standards and rec-

ommended practices (SARPS) which were submitted to the Air Navigation Commission. The modified ARPS will be approved for application in 1998.
Author (AIAA)
Civil Aviation; Flight Recorders; Air Navigation; Technology Assessment; International Cooperation; Aircraft Instruments

19980067167

Recording aircraft accident data requirement development - EUROCAE working group 50

Vincent, John, Civil Aviation Authority, UK; Perry, Tom, Civil Aviation Authority, UK; 1997, pp. 10.1-10.7; In English; Copyright; Avail: Aeroplus Dispatch

The purpose of this paper is to describe the EUROCAE working group 50. First, we look at the people and organizations involved. Considering both interests and organization we explore what brings so many specialists together to address this subject. Second, we look at the reasons for the creation of working groups. This includes a discussion of all important group terms of reference. Third, we look at the tasks allocated to the working group and the achievements that have been made, and those that need to be made, in order to produce workable documents. Finally, we use the historical perspective to show why subgroups have been created and what their role has become.
Author (AIAA)
Transport Aircraft; Aircraft Accident Investigation; Flight Recorders; Data Recording; Civil Aviation; Flight Safety

19980067168

Fire and crash protection

Barr, David, Penny & Giles Aerospace, Ltd., UK; 1997, pp. 11.1-11.7; In English; Copyright; Avail: Aeroplus Dispatch

The objective of this paper is to give the reader who is not familiar with the subject a general insight into how vital cockpit voice and flight data information is protected from the effects of aircraft crashes. It discusses the requirements imposed by regulations for protection of cockpit voice and flight data recorders, the techniques employed to protect the recording medium from the effects of fire and crashes, and the methods used to demonstrate compliance with the regulations. The paper describes the techniques used in general terms only, because the details of the methods that companies use to protect their recorders vary and the designs are often proprietary to the company and regarded as confidential.
Author (AIAA)
Cockpits; Fire Prevention; Crashes; Voice Communication; Flight Recorders; Data Recorders

19980067702

EMI from sources in the cargo bay

Cerino, Anthony, FAA, Technical Center, USA; Fuller, Gerald L., Veda, Inc., USA; Devereux, R. W., Veda, Inc., USA; 1997, pp. 4.1-9 to 4.1-16; In English; Copyright; Avail: Aeroplus Dispatch

The possibility of interference to avionics from sources in baggage in aircraft cargo bays has recently been investigated. This could apply to sources such as electronic baggage tags, inadvertent or intentional transmissions from baggage. Narrow and wide body jets carry their cargo in large open bays in the forward and aft areas under the passenger cabin. The principal avionics bays containing avionics systems are either forward or aft of the forward cargo bay and share a wall between them that is radio-transparent. Smaller secondary avionics bays are located in nose and aft compartments. Some avionics are also installed in cabinets with in the cargo bays. EMI sources in the cargo bays represent a possible threat source to the avionics in adjacent bays, avionics in the cargo bays themselves and to the communication, navigation, and identification (CNI) antennas mounted on the aircraft surface. Path loss calculations and measurements can be used to determine the coupling of these sources to the avionics, and susceptibility assessments can be made on that basis. Recent inspection of a wide range of commercial jets indicate there are many similarities in the physical relationship of the source locations and avionics and CNI antennas.
Author (AIAA)
Electromagnetic Interference; Avionics; Cargo Aircraft; Electromagnetic Shielding

19980067712

Statistical study of the distance of closest approach of aircraft to ground based emitters

Elliott, James R., Electro Magnetic Applications, Inc., USA; Perala, Rodney A., Electro Magnetic Applications, Inc., USA; 1997, pp. 4.3-1 to 4.3-8; In English; Copyright; Avail: Aeroplus Dispatch

The flight safety issues associated with the exposure of aircraft to High Intensity Radiated Fields (HIRF) are being addressed by the FAA. The current HIRF environment for aircraft certification is based on a worst-case evaluation of exposure, leading to a concern that the required test levels may be excessive and unnecessarily burdensome. A clearer understanding of the interaction

of HIRF with aircraft is desirable, in order to understand both the likelihood of occurrences and the intensity of encounters. This report primarily examines one of the main determinants of interaction, the closest approach of an aircraft to a HIRF emitter in the course of normal flight. Distributions of closest approach to any emitter were generated separately for Seattle and Denver. Flight operations with different beacon codes were examined for variations in the closest approach distributions. Local flight operations showed characteristics distinct from other types of flights. Minimum values of closest approach often occurred either at or very near airports. The results for Denver and Seattle shared general features but individual differences were noticeable. Issues of resolution, data reliability and validity of generalization to other airport sites are noted.
Author (AIAA)
Statistical Analysis; Flight Safety; Electromagnetic Radiation; Emitters

19980067713
Computing platform architectures for robust operation in the presence of lightning and other electromagnetic threats
Hess, Richards, Honeywell, Inc., USA; 1997, pp. 4.3-9 to 4.3-16; In English; Copyright; Avail: Aeroplus Dispatch

The electromagnetic environment (EME) produces (is a form of) electrical energy of the same type that is used by electrical/electronic equipment to process and transfer information. As such, this environment represents a fundamental threat to the proper operation of systems that depend on such equipment. For electrical/electronic systems providing functions that can affect the safe flight and landing of an aircraft (level A systems), the EME threat translates to a threat to the aircraft itself. When protection against EME effects is being developed, architectural techniques should be applied, particularly to achieve the high margin of safety needed for level A electrical/electronic systems. The computing platform for the Aircraft Information Management System used on the Boeing 777 aircraft and Versatile Integrated Avionics technology is an example of the application of an architectural philosophy in the design of the digital engine for such aircraft systems. Another is a prototype computing platform for rapid recovery from 'soft faults' (upset, momentary interference, etc.).
Author (AIAA)
Robustness (Mathematics); Lightning; Electromagnetic Radiation; Avionics

19980067714
Assessment of analytical codes for use in modeling aircraft onboard EMI threats
Devereux, R. W., Veda, Inc., USA; Archambeault, Bruce, Veda, Inc., USA; Fuller, Gerald L., Veda, Inc., USA; 1997, pp. 4.3-17 to 4.3-24; In English; Copyright; Avail: Aeroplus Dispatch

Determining the response of a wide variety of inservice aircraft types and avionics installations to onboard electromagnetic interference (EMI) is extremely difficult and very costly. In-service revenue bearing aircraft are difficult to access for sufficient periods of time to conduct experiments. Numerical models offer a solution to analyze EMI responses without major impact to in-service aircraft schedules and to reduce costly testing. A variety of software modeling programs are available, each offering different approaches with pros and cons to assessing unique aircraft installations stimulated by various EMI sources. A number of different modeling methods and readily available codes have been evaluated for suitability to analyze the specific aircraft onboard EMI problems. This paper discusses the problems needing to be addressed, available methods and codes for solving different aircraft related EMI problems, recommended methods for modeling specific aircraft EMI response problems, and available experimental data from different aircraft types used to validate the models.
Author (AIAA)
Electromagnetic Interference; Avionics

19980067716
Boeing's safety assessment processes for commercial airplane designs
Hasson, Jeff, Boeing Commercial Airplane Group, USA; Crotty, David, Scitor Corp., USA; 1997, pp. 4.4-1 to 4.4-7; In English; Copyright; Avail: Aeroplus Dispatch

Although the accident rate for transport category aircraft has improved substantially since the introduction of jet transports in the late 1950s, the rate has become approximately constant over the past 15 years. Since the number of aircraft operated in the airline fleets is projected to double over the next 20 years, a corresponding increase in the number of accidents is expected to result if the accident rate remains at its current level. The increased complexity and integration of aircraft systems, combined with the need to reduce the accident rate, have caused Boeing to enhance its methods of design safety. This paper discusses the processes Boeing uses to assure the safety of new aircraft designs.
Author (AIAA)
Commercial Aircraft; Aircraft Design; Flight Safety; Aircraft Accidents

19980067794

Limits to growth - Results from the detailed policy assessment tool

Wieland, Frederick, MITRE Corp., USA; 1997, pp. 9.2-1 to 9.2-8; In English; Copyright; Avail: Aeroplus Dispatch

Congestion-induced delay is one of the recognized metrics for assessing performance in NAS. Delay can arise from many causes, including factors specific to airline operations as well as factors that can be traced to NAS operations. In this paper we introduce a recently developed tool, the Detailed Policy Assessment Tool (DPAT), and use it to explore delay and the predictability of delay using some simple scenarios for NAS growth.

Author (AIAA)

Policies; National Airspace System; Time Lag; Air Traffic Control; Airline Operations; General Aviation Aircraft

19980067796

The value of Flight Information Services (FIS)

Flathers, G. W., II, MITRE Corp., USA; Dornbusch, Dana E., MITRE Corp., USA; 1997, pp. 9.2-16 to 9.2-22; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the applications and importance of FIS in various operational settings in NAS. The term FIS refers to the provision of flight information such as text or graphical weather data; the status of airports, airspace, and facilities; and other operational information directly to the cockpit. With this information, the pilot is better able to assess risks and opportunities in the flight environment, and consequently can make decisions which enhance safety and efficiency. to overcome the technical and operational limitations of the current voice radiotelephone system in delivering such information to the cockpit, several digital data link architectures are being considered for the future. Prior to evaluating candidate architectures, however, it is important to understand likely operational uses of FIS data. Toward this understanding, qualitative and quantitative estimates of the value, or importance, of FIS are included, along with a summary of how different user groups will use this data.

Author (AIAA)

National Airspace System; Information Systems; Cockpits

19980069450

Cloud particle measurements in thunderstorm anvils and possible weather threat to aviation

Lawson, R. P., SPEC, Inc., USA; Angus, Leigh J., SPEC, Inc., USA; Heymsfield, Andrew J., NCAR, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 113-121; In English

Report No.(s): AIAA Paper 96-0400; Copyright; Avail: Aeroplus Dispatch

Results from analysis of aircraft observations in the anvils of midlatitude and tropical thunderstorms are discussed. Aircraft and limited radar observations show that most anvils associated with small, garden-variety thunderstorms contain low (less than about 0.4 g/cu m) mass concentrations of ice particles. In larger, more intense midlatitude storms, anvils may contain ice water contents from 1 to 3 g/cu m. The mean of the maximum particle dimension in the anvil region of the more intense storms showed a strong modal size of about 2 mm. The particles themselves appear to be ice crystals and aggregates of ice crystals, i.e., snowflakes. The mass concentration of ice particles usually decreases rapidly away from the center of thunderstorms, falling off to less than half its peak value within about 10 km of the central region of the storms. The data suggest that the ice water content is well below 1 g/cu m at a distance of about 50 km away from the central region of a thunderstorm, i.e., the region with high radar reflectivity.

Author (AIAA)

Aviation Meteorology; Thunderstorms; Anvil Clouds; Clouds (Meteorology)

19980069849

Annual civil aviation report

ICAO Journal; Aug. 1997; ISSN 0018-8778; Volume 52, no. 6, pp. 5-9, 12, 13, (17 ff.); In English; Copyright; Avail: Aeroplus Dispatch

A survey is presented of the state of global commercial aviation for the year 1996. It is noted that the passenger throughput of the top 25 airports rose 6 percent above 1995 levels, while operating profits dropped slightly, and that the implementation of Communications-Navigation-Surveillance/Air Traffic Management systems continued at an accelerating pace throughout the world.

AIAA

Civil Aviation; Airline Operations

19980070283

Blast proof

Price, Antonia, UK; Aerospace International; Oct. 1997; ISSN 0305-0831; Volume 24,, no. 10, pp. 12-15; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation is conducted of the results of the UK Defense Evaluation and Research Agency's trial detonation of four simultaneous explosions within the cargo hold of a flight-pressurized 747-100 airliner. A survey is made of possible technological approaches to reduction of the degree of structures and systems damage caused by an explosion in flight.

AIAA

Boeing 747 Aircraft; Aircraft Safety; Blast Loads; Structural Failure; Explosions; Aircraft Accidents

19980070815

Introducing the 16LS high performance ejection seat

Miller, Brian A., Martin-Baker Aircraft Co., Ltd., UK; 1997, pp. 86-92; In English; Copyright; Avail: Aeroplus Dispatch

Since 1984, military specifications have required the development of microprocessor-controlled ejection seats. In more recent years, there is a greater emphasis on 'best value' rather than meeting all criteria; if most of the requirements for a particular system can be achieved at a substantially reduced cost, then that approach is likely to be adopted. This has introduced a freedom to seek alternative design approaches. Although Martin-Baker has successfully developed and produced over 1,000 first- and second-generation microprocessor-controlled ejection seats, this shift in procurement policy has been recognized as a permanent culture change, and the company has responded by finding more cost-efficient ways to attain many of the advantages of these advanced ejection seats. This paper describes the successful approach that has been taken and introduces the 16LS ejection seat that has already been selected for future fighter and advanced training aircraft.

Author (AIAA)

Ejection Seats; Numerical Control; Flight Crews; Microprocessors; Safety Factors; Military Technology

19980070818

Inflatable AeroStabilizers for NACES

Brown, Glen J., Vertigo, Inc., USA; 1997, pp. 113-122; In English; Copyright; Avail: Aeroplus Dispatch

The objective of Inflatable AeroStabilizers is to provide static aerodynamic stability to the NACES ejection seat. An associated systems study by Martin Baker Aircraft shows that this configuration will be highly effective in reducing the dynamic loads applied to the ejectee at airspeeds above 400 knots. Highest effectiveness is predicted for light crew members and adverse attitudes. The stabilizers are self-contained with deployment and inflation provided by pyrotechnic gas generators. Construction of the stabilizers is based on new high-pressure inflatable structures technology. The inflatable structure is a seamless flexible matrix of precisely oriented, high-tenacity fibers constructed using both braiding and weaving processes. Performance requirements include a 30 msec deployment interval initiated at canister clearance for a through-canopy ejection and completed by the time of seat-catapult separation. Design loads are based on 700 knots, Mach 1.2 emergence airspeed. Test results show major performance items, and physical characteristics being met, and demonstrate feasibility of this advanced structures approach.

Author (AIAA)

Inflatable Structures; Aerodynamic Stability; Ejection Seats; Static Stability; Bending Moments; Flight Crews

19980070829

A brief history of 'crashworthiness'

Waldock, William D., Embry-Riddle Aeronautical Univ., USA; 1997, pp. 228-245; In English; Copyright; Avail: Aeroplus Dispatch

A development history is presented for the concept and associated criteria of aircraft crashworthiness. The first general aviation aircraft deliberately engineered in order to minimize occupant injuries were produced in the late '40s, by such U.S. manufacturers as Piper and Beechcraft. Attention is given to the efforts of the National Transportation Safety Board's General Aviation Safety Panel in the early 1980s.

AIAA

Crashworthiness; Aircraft Accident Investigation; Technology Utilization; Military Aircraft; Aircraft Survivability

19980070830

Force-dependent parachute inflation control

Wittendorfer, Kurt E., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 246-255; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a methodology to control the inflation rate of a main parachute in response to the drag force developed by the inflating canopy. The long term goal is to achieve shorter inflation distances over an expanded 0-300 knots and 0-14,000 ft velocity-altitude envelope for an ejection seat main parachute without exceeding human tolerance to acceleration. A 26-ft conical parachute was constructed out of zero-porosity cloth to provide a much shorter nominal inflation distance and lower descent rate than a 28-ft flat circular canopy made of MIL-C-7020 cloth. Two elastically controlled circumferential vents were designed to control the rate of change of drag area of the inflating canopy such that, for a given deployment within this velocity-altitude envelope, the drag force would rapidly approach a prescribed 15-g maximum force for a 300-lb suspended weight, and maintain it until the kinetic energy is dissipated. Instrumented drop tests were performed and subsequent drag area versus distance curves were calculated for various fixed-size and two elastically controlled venting configurations. The limited data from this in-house research demonstrates improvements to the earlier methodologies and potential for improved performance in emergency escape from ejection seat aircraft.

Author (AIAA)

Recovery Parachutes; Canopies; Ejection Seats; Aerodynamic Drag; Shock Absorbers

19980070831

NACES P3I Phase I - A progress report

Lingard, J. S., Martin-Baker Aircraft Co., Ltd., UK; 1997, pp. 256-267; In English; Copyright; Avail: Aeroplus Dispatch

Martin-Baker is currently under contract with the U.S. Navy within the scope of the NACES Preplanned Product Improvement Program Phase I to provide for increased accommodation for the NACES ejection seat. This must be achieved while ensuring that the ejection injury risk for the range is equal to or less than the current injury risk for the extreme aircrew sizes/masses specified in the original NACES contract. These objectives will be met by four modifications to the seat: the provision of 1-inch increase in vertical adjustment; the provision of up to 1.6-inch forward adjustment of the seat back rest; revision of the catapult pyrotechnic design to reduce the Dynamic Response Index; reduction of free flight Dynamic Response Radical by the use of a reefed drogue. This paper discusses the design changes and their impacts on seat capability and performance.

Author (AIAA)

Ejection Seats; Ejection Injuries; Flight Crews; Structural Design; Aerodynamic Loads

19980070836

An overview of a method to perform FAR 25.562 FAA dynamic dynamic tests of seat restraint systems and occupant protection on transport aircraft

Bradney, Chris, Simula Technologies, Inc., USA; Ware, Keith, Simula Technologies, Inc., USA; 1997, pp. 311-320; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the engineering practices used to develop a state-of-the-art dynamic test facility that is equipped with multiple testing capabilities to evaluate seat restraint systems and occupant protection on transport aircraft. The facility includes an indoor drop tower and horizontal sled system, along with advanced computer modeling to meet FAA certification requirements.

Author (AIAA)

Transport Aircraft; Seats; Certification; Dynamic Tests; Crash Injuries

19980070853

Mishap data evaluation of current naval aircraft 1987-1996

Hennings, Elsa J., U.S. Navy, Weapons Div., USA; 1997, pp. 465-475; In English; Copyright; Avail: Aeroplus Dispatch

This report documents a study of U.S. Naval mishap data from January 1987 to September 1996 involving F/A-18A, B, C, D; AV-8B/TAV-8B; F-14A, B, C, D; EA-6B; T-45; T-2; S-3; and TA-4 aircraft. The study was conducted to determine which technological improvements in aircraft and aircrew safety systems might reduce the mishap/injury/lethality rates of the subject aircraft and crewmembers. Data were first sorted into aircraft categories, losses/year, platforms, and mishaps/100,000 flight hours by year and by platform. The crewmembers were then sorted into injury categories. For those crewmembers in the categories of fatality, permanent total disability, permanent partial disability, and major injury, the data were sorted into eject/no eject categories and

then into technology categories that may have prevented the fatality or injury, first for the entire group and then for only those crewmembers who ejected. The results of this study indicate that 268 aircraft have been lost in the 10 years studied. These mishaps involved 416 crewmembers, 192 (46.2 percent) of whom were killed, disabled, or received a major injury. Of these 192 crewmembers, the largest number of fatalities and injuries (43.2 percent) may have been eliminated if an automatic ejection system were available.
Author (AIAA)
Aircraft Performance; Flight Crews; Flight Safety; Injuries; Death; Ejection Seats

19980071101
The new ERA in Europe
Field, Hugh, Royal Aeronautical Society, UK; Aerospace International; Nov. 1997; ISSN 0305-0831; Volume 24,, no. 11, pp. 10, 11; In English; Copyright; Avail: Aeroplus Dispatch

A survey is presented of the climate of opinion at the 1997 meeting of the European Regional Airlines (ERA) Association. Attention is given to such operational issues as the growing variety of 50-70-seat turbofan-powered regional airliners available, and such regulatory issues as the European Union’s decision to outlaw duty-free goods within Europe, which the ERA opposes.
AIAA
Airline Operations; Organizations; Europe; Civil Aviation; Air Transportation; Regulations

19980071647
Testing a new model of ram-air parachute inflation
Potvin, J., Saint Louis Univ., USA; Aeronautical Journal; Sep. 1997; ISSN 0001-9240; Volume 101,, no. 1007, pp. 299-313; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports on the experimental validation of a new model of slider-reefed ram-air parachute opening, using jump data collected by this investigator and others. The model is based on the parachute load equation of motion coupled with a new differential equation which describes the rate of change of the parachute’s drag area. The model clearly identifies the important factors which determine the inflation peak load and opening time. It also features many scaling relationships useful for design work. Several predictions are shown to be design-independent. The experimental data used in this model validation were gathered during sport parachuting jumps performed by this author. Also used are data generated by the U.S. Navy during tests of the MC-5, MT-1X/SL, and MT-1XX parachutes. The experimental results and model predictions are found to agree within 20 percent accuracy over a wide range of opening speeds and deployment altitudes.
Author (AIAA)
Performance Tests; Equations of Motion; Free Fall; Deceleration

19980072314
Effect of winter elements on aircraft braking performance under study at Canadian site
Mazur, Al, Transport Canada Aviation, Ottawa, Canada; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 15, 16; In English; Copyright; Avail: Aeroplus Dispatch

An international research team is in the midst of a five-year project to develop standards and procedures for the recording and reporting of wintertime runway contaminants. One goal is to develop an improved method for determining landing and accelerated-stopping distance requirements when operating on runways contaminated by ice, snow, and slush.
Author (AIAA)
Winter; Aircraft Brakes; Aircraft Performance; Runways

19980072361
Automation and decision making - Lessons from the Cali accident
Strauch, Barry, National Transportation Safety Board, USA; 1997, pp. 195-199; In English; Copyright; Avail: Aeroplus Dispatch

The accident involving an American Airlines Boeing 757 that crashed on approach to Cali, Colombia, in December 1995, was examined to better understand the errors that the pilots committed. Their loss of situation awareness about their proximity to terrain resulted from several factors involving their use of the flight management system (FMS) under high workload conditions. The implications of FMS use on our understanding of situation awareness and decision making are explored.
Author (AIAA)
Automation; Decision Making; Aircraft Accidents; Pilot Error; Flight Management Systems; Man Machine Systems; Workloads (Psychophysiology)

19980072394

The comprehensibility of airline safety card pictorials

Caird, J. K., Calgary, Univ., Canada; Wheat, B., Simon Fraser Univ., Canada; McIntosh, K. R., Calgary, Univ., Canada; Dewar, R. E., Calgary, Univ., Canada; 1997, pp. 801-805; In English; Copyright; Avail: Aeroplus Dispatch

Airline safety cards are an integral component of passenger safety information. Brochures depict compulsory safety and emergency information such as how to adjust a seatbelt and how to exit a plane in an emergency. Few cards, however, have been developed that consider whether or not passengers actually understand the information contained on the cards. A study is reported that examined the efficacy of airline safety cards to convey the meanings of safety and emergency information. One-hundred and thirteen participants were given a questionnaire that tested the comprehension of 36 airline pictorials selected from 50 airline safety cards. Comprehension for most of the pictorial information was uniformly low. Twelve met the International Organisation of Standards (ISO) comprehension standard. An analysis of 'emergency floor lighting' and 'do not use electronics' is given.
Author (AIAA)

Aircraft Safety; Airline Operations; Safety Management; Information Dissemination; Passengers; Cognitive Psychology; Images

19980072395

Comprehension of aviation safety pictograms - Gender and prior safety card reading influences

Silver, N. C., Nevada, Univ., Las Vegas, USA; Perlotto, Carla N., Nevada, Univ., Las Vegas; 1997, pp. 806-810; In English; Copyright; Avail: Aeroplus Dispatch

The present study assessed the comprehensibility of aviation safety pictorials that compose specific pictograms. A total of 120 individuals were asked to provide detailed responses to each pictorial that comprised a pictogram. The seven categories of pictograms were: (1) take-off, landing, and surface movement; (2) oxygen; (3) in flight; (4) land evacuation; (5) emergency/brace position and floor lighting; (6) water evacuation; and (7) water evacuation - on overwater aircraft. Results indicated that 21 of the 40 pictorials presented were within the acceptable range of the ISO 67 percent comprehension criterion, whereas only 11 of the 40 pictorials were within the ANSI 85 percent comprehension criterion. Comprehension of the pictorials comprising the oxygen pictogram was the highest among the seven categories of pictograms tested. However, the pictorials that connoted 'move away from the aircraft', which were found in the land evacuation pictograms, were the least comprehended. Implications for aviation safety card design are discussed.
Author (AIAA)

Safety Management; Information Dissemination; Passengers; Aircraft Safety; Cognitive Psychology; Images

19980072459

Explosive detection - Choosing the best system

Airport technology international 1998; 1997, pp. 25, 26, 28; In English; Copyright; Avail: Aeroplus Dispatch

General guidelines are presented for choosing the most effective baggage explosive detection system for airports. The integration of baggage screening into airport operations is discussed.
AIAA

Explosives; Airport Security; Detection

19980072465

China harnesses Western airliner technology

Woolley, David, UK; Airport technology international 1998; 1997, pp. 89, 90, 93, 94; In English; Copyright; Avail: Aeroplus Dispatch

The explosive growth of Chinese civil aviation, and the role of Western technology in fuelling it, are discussed. Attention is given to privatization of Chinese civil aviation and to the use foreign-supplied aircraft in Chinese civil aviation.
AIAA

China; Airline Operations

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19980049687

The mush zone - A slurpy layer lurks deep inside the planet

Monastersky, Richard, USA; Science News; Feb. 14, 1998; ISSN 0036-8423; Volume 15, no. 7, pp. 109-111; In English; Copyright; Avail: Aeroplus Dispatch

Recent seismological observations suggest the existence of a partially molten layer at the base of the mantle, which has been termed the Ultra Low Velocity Zone (ULVZ). Although this zone lies 2850 km down, almost halfway to the center of the planet, emerging evidence suggests that it may have direct relevance to life on the surface. The zone appears to determine where massive volcanic eruptions occur and perhaps where ocean basins form. It could play an important role in shaping the very face of the planet.

AIAA

Lithosphere; Earth Core; Mushy Zones

19980049759

CADDRAD - A physical optics radar/radome analysis code for arbitrary 3D geometries

Shifflett, James A., Boeing Advanced Systems and Technology, USA; IEEE Antennas and Propagation Magazine; Dec. 1997; ISSN 1045-9243; Volume 39, no. 6, pp. 73-79; In English; Copyright; Avail: Aeroplus Dispatch

CADDRAD is a radar/radome analysis code meant to aid in the design of modern radar radomes. Arbitrary radome shapes may be input in a standard format used by CAD software. Multilayered radomes, with thickness tapers in all layers, may be used. The radar may be either electronically or mechanically scanned. The underlying theory implemented in the code is discussed. Comparisons are shown between measurements and predictions of reflection lobes, beam peak loss, and boresight error.

Author (AIAA)

Computer Programs; Radomes; Computer Aided Design; Physical Optics; Antenna Design

19980051558

Multiple unit ground holding strategy problem research

Hu, Minghua, Nanjing Univ. of Aeronautics and Astronautics, China; Chen, Aimin, Nanjing Univ. of Aeronautics and Astronautics, China; Xu, Xiaohao, Nanjing Univ. of Aeronautics and Astronautics, China; Yuan, Weidong, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 42-46; In Chinese; Copyright; Avail: Aeroplus Dispatch

One of the most important functions of any traffic management system is the optimal assignment of ground-holding times to flight, i.e., the determination of weather and by how much the take-off of a particular aircraft headed for a congested part of the ATC system should be postponed in order to reduce the likelihood and extent of airborne delays. Considering the restriction of multiple airport and airspace capacity, a multiple unit ground holding strategy problem with deterministic capacity is studied, including the mathematical model and a new algorithm based on a heuristic method and artificial intelligence. The algorithm is verified using practical flight data for the Guangzhou area. The results show that the new algorithm is feasible.

Author (AIAA)

Air Traffic Control; Artificial Intelligence; Takeoff

19980051562

Modelling and simulation of GPS Wide-Area Augmentation System (WAAS)

Fan, Shenglin, Nanjing Univ. of Aeronautics and Astronautics, China; Hu, Guohui, Nanjing Univ. of Aeronautics and Astronautics, China; Yuan, Xin, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 17-21; In Chinese; Copyright; Avail: Aeroplus Dispatch

The implementation of the Wide-Area Augmentation System is studied. The master station can compute three-dimensional ephemeris errors, equivalent range errors of satellite clock offsets including SA errors, ionospheric time delay parameters and integrity information based on the information gathered by reference stations. The error corrections and integrity information are then transmited to users. The simulation results indicate that the GPS position accuracy can be potentially increased by using the error corrections and does not vary with the user position over a larger area.

Author (AIAA)

Global Positioning System; Computerized Simulation

19980055346

Performance of sensor alignment with Earth-referenced coordinate systems for multisensor data fusion

Zhou, Yifeng, Telexis Corp., Canada; Leung, Henry, Defence Research Establishment Ottawa, Canada; Bosse, Eloi, Defence Research Establishment Valcartier, Canada; Optical Engineering; Feb. 1998; ISSN 0091-3286; Volume 37, no. 2, pp. 524-531; In English; Copyright; Avail: Aeroplus Dispatch

A least-squares sensor alignment algorithm is formulated using the Earth-centered Earth-referenced (ECEF) coordinate system, and the first order perturbation theory is used to evaluate the impact of the sensor elevation measurement errors on alignment performance. A modified generalized least-squares (MGLS) alignment method is then developed which is based on the statistical modeling of the elevation measurement errors. The performance of the sensor alignment algorithm proposed here is demonstrated through computer simulations.

AIAA

Multisensor Fusion; Alignment; Multisensor Fusion; Surveillance Radar

19980056434

Multisensor tracking system with attitude measurements

Ding, Chibiao, Beijing Univ. of Aeronautics and Astronautics, China; Mao, Shiyi, Beijing Univ. of Aeronautics and Astronautics, China; Chinese Journal of Aeronautics; Nov. 1997; ISSN 1000-9361; Volume 10, no. 4, pp. 281-287; In English; Copyright; Avail: Aeroplus Dispatch

A new 3D fusion tracking system for an anti-air missile homing system based on radar and an imaging sensor is developed. The attitude measurements from the imaging sensor are used to improve the tracking performance. Computer simulation results show that the tracking system greatly reduces the tracking errors compared with trackers without attitude measurements and achieves small miss distances even when the target has a big maneuver.

Author (AIAA)

Tracking (Position); Antimissile Defense; Homing Devices; Multisensor Fusion; Radar Imagery

19980056656

Communication between cabin and maintenance crews

Aerospace Engineering; Feb. 1998; ISSN 0736-2536; Volume 18, n, nos. 1-2, pp. 26, 27; In English; Copyright; Avail: Aeroplus Dispatch

A study has been conducted of the human factors affecting communications concerning aircraft maintenance within a private fleet. Analysis of the data thus obtained has suggested that prompt resolution of discrepancies was closely related to experience and system-related knowledge. It is suggested that verbal and written discrepancy reporting be incorporated into student pilot-student mechanic interaction during training.

AIAA

Aircraft Compartments; Human Factors Engineering; Aircraft Maintenance; Ground Crews; Aircraft Pilots

19980056672

Cargo airliners to test ADS-B

Nordwall, Bruce D., USA; Aviation Week & Space Technology; Jan. 05, 1998; ISSN 0005-2175; Volume 14, no. 1, pp. 63, 64; In English; Copyright; Avail: Aeroplus Dispatch

The Cargo Airline Association is the leader of an effort to evaluate the Automatic Dependent Surveillance-Broadcast (ADS-B) system that is a critical element of 'free flight' air traffic management. Aircraft equipped with ADS-B will automatically transmit GPS position, altitude, and velocity vector information over a data link, as often as required by ground controllers; a 1/sec transmission rate would provide aircraft positions superior to those of most radars.

AIAA

Cargo Aircraft; Flight Tests; Global Positioning System; Broadcasting; Air Traffic Control

19980056834

A photonically controlled airborne SATCOM array designed for the SHF band

Ng, W., Hughes Research Labs., USA; Loo, R., Hughes Research Labs., USA; Tangonan, G., Hughes Research Labs., USA; Lee, J. J., Hughes Aircraft Co., USA; Chu, R., Hughes Aircraft Co., USA; Livingston, S., Hughes Aircraft Co., USA; Rupp, F., Hughes Aircraft Co., USA; 1997, pp. 11-16; In English; Copyright; Avail: Aeroplus Dispatch

We describe the architecture of an airborne SATCOM antenna that is photonically controlled. Specifically, the active array antenna is designed to transmit/receive in the SHF frequency band of 7.25-8.4 GHz. We emphasize, in particular, the remoting

of the array front-end and the performance enhancements gained by adopting true-time-delay steering via the insertion of photonic technology.
Author (AIAA)
Airborne Equipment; Optical Control; Photonics; Satellite Antennas; Antenna Arrays; Satellite Communication

19980057556
GPS/GLONASS/INS-navigation (GLOGINAV)
Beerhold, J. R., LITEF GmbH, Germany; 1997, pp. 13.0-13.16; In English; Copyright; Avail: Aeroplus Dispatch

The GLOGINAV integrated navigation system consists of a modified commercial LITEF FOG AHRS with micromechanical accelerometers, a 12-channel avionic GPS/GLONASS receiver, a local area augmentation station based on a 24-channel GPS/GLONASS receiver, and a data recording and visualization unit. A 19-state closed-loop Kalman filter is used to calibrate the inertial equipment with GPS/GLONASS sensor information. The readouts of the calibrated inertial sensors are then used to compute the principal navigation information, namely position and velocity. As a result, short- to medium-term GPS/GLONASS dropouts or erroneous measurements can be bridged in autonomous navigation mode. The general design, technical aspects, and performance characteristics of the system are described.
AIAA
Global Positioning System; GLONASS; Inertial Navigation; Hybrid Navigation Systems

19980057830
The development of nuisance warning criteria for ground collisions avoidance systems - Preliminary findings
Prosser, K. E., USAF, 416th Flight Test Squadron, USA; Skoog, M. A., USAF, 416th Flight Test Squadron, USA; Fergione, J. A., Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 307-318; In English; Copyright; Avail: Aeroplus Dispatch

The USA Air Force (USAF) has been actively pursuing ground collision avoidance system (GCAS) technology for the past decade. Despite this effort, controlled flight into terrain (CFIT) remains the number one cause of aircraft losses in the USAF. Research suggests that the primary limitation of current GCAS technology is the excessive occurrence of nuisance warnings. Pilots quickly learn to 'tune out' GCAS warnings or turn the systems off entirely to avoid these false warnings. Currently, no criteria exists to indicate the threshold between valid warnings and those that will be considered nuisances by the pilots. The purpose of this nuisance criteria study was to develop just such a criterion that GCAS designers can use to optimize their systems to avoid nuisance warnings.
Author (AIAA)
Collision Avoidance; Aircraft Pilots

19980059154
Technologies learned from the Terminal Area Surveillance System (TASS) program
Tidwell, Cam J., Jr., FAA, USA; Little, Arthur D., FAA, USA; 1997, pp. 260, 261; In English; Copyright; Avail: Aeroplus Dispatch

The FAA's TASS program is tasked with the development of a multipurpose radar system capable of performing both aircraft and weather surveillance. The areas of technology that have been stressed during TASS development encompass cost reduction criteria as well as electronically (E) scanned meteorological surveillance; the E-scan system provides full polarization diversity for the detection of critical weather functions.
AIAA
Surveillance Radar; Research and Development; Meteorological Radar

19980059156
Aircraft and hazardous weather detection algorithms in the multi-purpose airport radar
Smith, Michael E., Lockheed Martin Corp., USA; Kessinger, Cathy, NCAR, USA; 1997, pp. 264, 265; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the Multi-Purpose Airport Radar (MPAR) data acquisition operations, high-speed Digital Signal Processor, and algorithms for aircraft and weather surveillance functions. MPAR uses an active phased-array antenna to provide pencil-beam coverage of desired surveillance volumes, in the tasks of aircraft and hazardous weather detection.
AIAA
Weather Forecasting; Surveillance Radar; Aircraft Detection; Radar Detection; Hazards; Doppler Radar

19980059168

Aircraft wake vortex detection trials with C-band instrumentation radar

Katz, Sheldon L., Lockheed Martin Government Electronic Systems, USA; Hudson, Bruce, Lockheed Martin Government Electronic Systems, USA; Pschunder, Harald, Lockheed Martin Government Electronic Systems, USA; Lupnacca, John D., Lockheed Martin Government Electronic Systems, USA; Marshall, Robert E., Research Triangle Inst., USA; 1997, pp. 163, 164; In English; Copyright; Avail: Aeroplus Dispatch

Detection of wingtip vortices by radar in a range of weather conditions is desirable. Experimental trials have been conducted by the FAA in order to identify the most reliable techniques for discriminating wingtip vortex radar echoes from wind-generated echoes; attention was given to the dependence of vortex signatures on flow orientation relative to the radar beam and aircraft altitude.

AIAA

Aircraft Wakes; C Band; Air Traffic Control; Wing Tip Vortices; Radar Tracking

19980059170

The capabilities and limitations of using the ASR-9 as a terminal area precipitation sensor

Crowe, Bradley A., MIT, USA; Isaminger, Mark A., MIT, USA; Weber, Mark E., MIT, USA; Cullen, Joseph A., MIT, USA; 1997, pp. 168-171; In English; Copyright; Avail: Aeroplus Dispatch

The present examination of ten cases of storm cell underestimation or elimination by the Airport Surveillance Radar-9 (ASR-9) also compared its data with Weather System Processor data. In about one-third of cases, the ASR-9 underestimated maximum echo intensity, and was able to entirely miss storm cells close to the radar’s location.

AIAA

Surveillance Radar; Precipitation (Meteorology); Doppler Radar; Meteorological Radar

19980059171

Multi-Purpose Airport Radar for terminal-area air traffic control

Williams, Stuart E., Lockheed Martin Corp., USA; 1997, pp. 172, 173; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the capabilities of the demonstrator for the Multi-Purpose Airport Radar system, which has been designed to provide simultaneous multifunction target/weather surveillance. Attention is given to the system’s control monitoring, radar control processor, antenna, transmitter/receiver, and digital signal processor subsystems.

AIAA

Air Traffic Control; Radar Tracking; Surveillance Radar; Weather Forecasting

19980060370

A novel solution-technique applied to a novel WAAS architecture

Bavuso, Salvatore J., NASA Langley Research Center, USA; 1998, pp. 229-234; In English; Copyright; Avail: Aeroplus Dispatch

One system that uses the GPS to determine aircraft navigational information is called the Wide Area Augmentation System (WAAS). This paper describes a reliability assessment of one candidate system architecture for the WAAS. A unique aspect of this study regards the modeling and solution of a candidate system that allows a novel cold sparing scheme. The cold spare is a WAAS communications satellite that is fabricated and launched after a predetermined number of orbiting satellite failures have occurred and after some stochastic fabrication time transpires. Because these satellites are complex systems with redundant components, they exhibit an increasing failure rate with a Weibull time to failure distribution. Moreover, the cold spare satellite build-time is Weibull, and upon launch is considered to be a good-as-new system with an increasing failure rate and a Weibull time to failure distribution as well. The reliability model for this system is non-Markovian because three distinct system clocks are required: the time to failure of the orbiting satellites, the build time for the cold spare, and the time to failure for the launched spare satellite. A powerful dynamic fault tree modeling notation and Monte Carlo simulation technique with importance sampling are shown to arrive at a reliability prediction for a 10-year mission.

Author (AIAA)

Global Positioning System; Architecture (Computers); Air Transportation

19980062354

New ATC techniques keep air traffic flowing

Ott, James, USA; Aviation Week & Space Technology; Feb. 02, 1998; ISSN 0005-2175; Volume 14, no. 5, pp. 51-53; In English; Copyright; Avail: Aeroplus Dispatch

Current efforts by the FAA Air Traffic Services division to improve air traffic control performance are discussed. In particular, attention is given to changes in the operational and procurement policy of the FAA. The current focus is on the quick fielding of new systems and new technology based on the best technology available at the moment rather than continuing to wait for the very best and not fielding anything. The present scaled-down modernization program of the FAA, which is part of an estimated 34-billion dollar program, is briefly reviewed.
AIAA
Air Traffic Control; Upgrading

19980063070

Enhanced capability of GPS and its augmentation systems meets navigation needs of the 21st century

Johns, James C., FAA, USA; ICAO Journal; Nov. 1997; ISSN 0018-8778; Volume 52, no. 9, pp. 7-10; In English; Copyright; Avail: Aeroplus Dispatch

The next significant step in the FAA's plant to implement a satellite-based navigation system is the wide area augmentation system, WAAS, which will satisfy FAA requirements for primary means navigation down to, and including, Category I precision approaches. A ground-based local area augmentation system will subsequently satisfy FAA requirements for Category II and III precision approaches.
AIAA
Global Positioning System; Technological Forecasting; Satellite Instruments

19980063071

Capability and performance make GLONASS suitable for navigation in all phases of flight

Kuranov, Viktor, Federal Aviation Authority, Russia; Iovenko, Yuri, Federal Aviation Authority, Russia; ICAO Journal; Nov. 1997; ISSN 0018-8778; Volume 52, no. 9, pp. 11, 12, 26; In English; Copyright; Avail: Aeroplus Dispatch

As part of the ICAO's program of aggressive satellite technology employment encompasses within its Global Navigation Satellite System scheme both GPS and the GLONASS commercial system launched by Russia in 1995. A Russian industrial venture is developing an airborne receiver that will operate with GPS and GLONASS simultaneously.
AIAA
GLONASS; Air Navigation; Global Positioning System; Flight Instruments

19980063076

Inventory of available code assignments for use in the SELCAL system has been depleted

Godberson, Edward R., ICAO, Air Navigation Bureau, Canada; ICAO Journal; Nov. 1997; ISSN 0018-8778; Volume 52, no. 9, pp. 18, 19; In English; Copyright; Avail: Aeroplus Dispatch

The inventory of codes available for use by the selective calling 'SELCAL' system, which permits selective communications with individual aircraft over the aeronautical mobile voice channels, was exhausted in 1997. In order to cope with the shortage, aircraft are being assigned duplicate codes; until a system-wide fix becomes available, this situation calls for exacting compliance with rediotelephony voice channel procedures.
AIAA
Aircraft Communication; Voice Communication; Telephony; Communication Theory

19980065559

Aircraft vertical profile prediction based on surveillance data only

Manolakis, D. E., Technological Education Inst. of Thessaloniki, Greece; IEE Proceedings: Radar, Sonar and Navigation; Oct, 1997; ISSN 1350-2395; Volume 144, no. 5, pp. 301-307; In English; Copyright; Avail: Issuing Activity

The paper is concerned with aircraft vertical profile prediction. It presents methods which combine stored performance characteristics and trajectory observation data to predict the profile. Also, it derives some new methods which estimate the trajectory defining coefficients directly from vertical surveillance data. Performance results are also included for comparison between the category of methods which uses aircraft performance characteristics and the second category of methods that does not use performance data. The advantage of the new methods is that they cater for all aircraft types and operating conditions and can better exploit the higher reporting rates.
Author (EI)
Air Traffic Control; Air Navigation; Trajectories

19980067060

Research on the fusion technology for inertial integrated navigation systems

Liu, Jianye, Nanjing Univ. of Aeronautics and Astronautics, China; Yuan, Xin, Nanjing Univ. of Aeronautics and Astronautics, China; Sun, Yongrong, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1005-2615; Volume 29, no. 4, pp. 372-377; In Chinese; Copyright; Avail: Aeroplus Dispatch

In view of the existing situation in inertial integrated systems with multisubnavigation, the measurement fusion technology applicable to the integrated system is investigated. The design idea and schemes of the measurement fusion are discussed. Taking INS, GPS, VOR/DME and TAN (terrain aided navigation) as examples, the fusion algorithm of integrated navigation system is analyzed. With these analyses and Monte Carlo method simulation, it is concluded that the design of the measurement fusion navigation system is successful and has practical value for the inertial integrated system.

Author (AIAA)

Inertial Navigation; Systems Integration; Multisensor Fusion

19980067259

An efficient counter-countermeasure of the spinning concentric annular ring reticle seeker

Hong, Hyun-Ki, Chung-Ang Univ., Republic of Korea; Han, Sung-Hyun, Chung-Ang Univ., Republic of Korea; Choi, Jong-Soo, Chung-Ang Univ., Republic of Korea; 1997, pp. 10-19; In English; Copyright; Avail: Aeroplus Dispatch

Reticle systems, which are widely used in infrared missile seekers, are considered to be the classical approach for estimating the position of a target in the FOV. This paper presents a new simulation tool that gives tracking results of the concentric annular ring reticle seeker in various cases. Our simulation model is applicable to the development of the advanced seekers. While false targets such as flares are presented in the FOV, simulation results show that the existing seeker cannot determine a precise target location. In order to decrease the susceptibility to countermeasures such as flares, we propose an efficient counter-countermeasure using signal prediction. In the simulation results, we have ascertained that the reticle seekers using our technique can perform more effective target tracking than previous seekers.

Author (AIAA)

Reticles; Ring Structures; Tracking (Position); Homing Devices; Optical Countermeasures

19980067260

Dynamic simulation of infrared reticle seekers

Hong, Hyun-Ki, Chung-Ang Univ., Republic of Korea; Han, Sung-Hyun, Chung-Ang Univ., Republic of Korea; Choi, Jong-Soo, Chung-Ang Univ.; Seoul National Univ., Republic of Korea; 1997, pp. 20-29; In English; Copyright; Avail: Aeroplus Dispatch

A dynamic simulator of the reticle seekers has been developed to predict the tracking performance in various engagement scenarios. We can analyze the performance of the infrared reticle seekers with various positions of targets in the FOV, with several SNRs. We have shown that the presented simulator is a very powerful means for developing the signal processing algorithms in the presence of infrared countermeasures (IRCM). A simple and efficient algorithm for infrared counter-countermeasures (IRCCM) is proposed and simulated. With the incorporation of this IRCCM technique into the reticle seeker in the presence of IRCM, the missile can intercept its target successfully.

Author (AIAA)

Dynamic Models; Reticles; Infrared Detectors; Tracking (Position); Optical Countermeasures

19980067603

Beating the weather

Warwick, Graham, UK; Flight International; Sep. 30, 1997; ISSN 0015-3710; Volume 152,, no. 4593, pp. 56, 57; In English; Copyright; Avail: Aeroplus Dispatch

The goals of NASA's Terminal Area Production (TAP) are to allow more operations per runway and more runways per airport in conditions of deteriorating weather. TAP has conducted the Low Visibility Landing and Surface Operations (LVLASO) program to allow full-tempo operations to continue as weather worstens. LVLASO involves rapid use of exits by aircraft upon landing, the provision of taxi guidance and traffic information in low visibility, and the accurate detemination by ATC of approach spacing.

AIAA

Runway Conditions; Collision Avoidance; Weather; Computer Graphics; Cockpits

19980067651

Digital beam forming for tactical airborne radars

Hopwood, Francis, Northrop Grumman Corp., USA; Leahy, Kevin, Northrop Grumman Corp., USA; Difurio, Anthony, Northrop Grumman Corp., USA; 1997, pp. 0.1-1 to 0.1-7; In English; Copyright; Avail: Aeroplus Dispatch

Digital Beam Forming Array (DBFA) architectures promise significant performance advantages over contemporary antenna architectures. We attempt here to identify and address certain issues that are key to a practical DBFA system. We discuss our 'visionary' ultrawideband DBFA concept for future development, as a new generation of devices becomes available. We also focus on nearer-term concepts for high performance tactical airborne radar applications that require very high dynamic range signals to detect small targets in large clutter. We note some receiver tradeoffs, dynamic range and processor sizing considerations for near-term DBFA.

Author (AIAA)

Beamforming; Airborne Radar; Digital Filters; Arrays

19980067654

Shaping the National Airspace System for the 21st century

Burke, Gregory, FAA, Office of System Architecture, USA; 1997, pp. 0.4-1 to 0.4-7; In English; Copyright; Avail: Aeroplus Dispatch

Shaping the National Airspace System (NAS) for the 21st century requires a clear understanding of the goal to be acheived as well as a firm grasp of the improvements which must be made to achieve that goal. This paper provides a description of the characteristics of a modernized NAS, the goal of current improvement efforts, as well as a description of the improvements that must be made in each functional area to provide the characteristics described.

Author (AIAA)

National Airspace System; Technological Forecasting; Air Traffic Control

19980067689

ADS-B/CDTI capabilities for near-term deployment - Some early results

Mundra, Anand, MITRE Corp., USA; Cieplak, James C., MITRE Corp., USA; Domino, David A., MITRE Corp., USA; Olmos, Baltazar O., MITRE Corp., USA; Stassen, Hans P., MITRE Corp., USA; 1997, pp. 3.1-28 to 3.1-35; In English; Copyright; Avail: Aeroplus Dispatch

This paper documents a proposed set of near-term applications of a cockpit display of traffic information (CDTI), which may be deployed in terminal and oceanic regions. It presents some results of simulations to determine the efficacy of specific CDTI information facilitating some of the early steps in this evolution. These formulations and results are being used by RTCA in developing minimum operational performance standards for a CDTI.

Author (AIAA)

Cockpits; Display Devices; Traffic Control; Air Traffic Control

19980067701

Further analysis of the CV-580 and B-727 aircraft RF coupling experiment data

Devereux, R. W., Veda, Inc., USA; Fuller, Gerald L., Veda, Inc., USA; Schillinger, Ray, FAA, Technical Center, USA; 1997, pp. 4.1-1 to 4.1-8; In English; Copyright; Avail: Aeroplus Dispatch

RF coupling research of a moderate size aircraft cavity was conducted on the FAA's CV-580 research aircraft. This paper discusses the refined results of our recent analysis of over 500 digitized spectrum data files and many additional observational notes. The results presented are based upon further refinement of the digitized date with corrections for cable loss, amplifier gain, and antenna factors. These corrected data are correlated to test points and configurations in order to provide better insight into the overall RF coupling behavior of the CV-580 aircraft. This analysis emphasizes the aircraft receiver in-band frequency susceptibility, primarily the microwave frequency bands used for aircraft GPS and SATCOM navigation. This report also includes VOR, VHF, UHF and DME navigation and communication frequency bands. The evaluation is focused on coupling behavior from inside the aircraft cavity, coupling through the windows, to the aircraft receiver antennas. Several window effects were analyzed at different frequencies and polarities, including full and partial window shielding configurations. Leakage into receiver cables from an inside source is also discussed.

Author (AIAA)

Boeing 777 Aircraft; Radio Frequencies; Microwave Coupling; Research Aircraft

19980067737

Exploration of key operational issues for the midterm NAS

Lunsford, Clark R., MITRE Corp., USA; 1997, pp. 6.1-1 to 6.1-8; In English; Copyright; Avail: Aeroplus Dispatch

FAA's Flight 2000 project is an innovative initiative to implement and validate selected operational improvements leading to free flight. It integrates new avionics, new ground systems, new procedures, avionics certification, and operational approval. This paper discusses some key operational issues that need to be resolved in developing new capabilities for NAS to ensure that they will result in improved NAS operations. Three experiments are described that are proposed for Flight 2000 to explore the feasibility and utility of planned operational improvements. The implications for the NAS architecture and the expected impact on NAS operations are also discussed.

Author (AIAA)

Free Flight; Air Traffic Control; National Airspace System

19980067739

Collins GLS architecture for regional and business aircraft

Pederson, Barbara A., Rockwell Avionics and Communications, USA; McCall, Daryl L., Rockwell Avionics and Communications, USA; 1997, pp. 6.1-16 to 6.1-22; In English; Copyright; Avail: Aeroplus Dispatch

To facilitate growth to a GNSS landing system (GLS) capability, new functional requirements must be anticipated and basic airborne requirements (accuracy, integrity, availability, and continuity) allocated to individual aircraft components. The Collins Pro Line 4 architecture has integrated the ARINC 743A compliant GPS4000 in a manner that supports migration to GLS by provisioning for forward-compatibility with the Collins' differential GPS (DGPS) approach sensor, the APR4000, and leveraging the Pro line 4 existing ILS interfaces. The paper presents, by example, the ability of this system architecture to adapt and support SCATI, LAAS, and WAAS-based GLS operations.

Author (AIAA)

Global Positioning System; General Aviation Aircraft

19980067759

Controller Interface for Controller-Pilot Data Link Communications

Rankin, J. M., Saint Cloud State Univ., USA; Mattson, P. R., Saint Cloud State Univ., USA; 1997, pp. 7.1-19 to 7.1-25; In English; Copyright; Avail: Aeroplus Dispatch

The Controller Interface was designed to generate Air Traffic Controller messages per RTCA DO-219 for Controller-Pilot Data Link Communications (CPDLC). The Controller Interface is part of the Low Visibility Landing and Surface Operations (LVLASO) project being researched by NASA/Langley and NASA/Ames. The messages implemented in the Controller Interface were tailored for the ground controller to handle airport surface traffic. of primary concern were messages related to taxi routes and hold-short instructions. These messages drive the moving map display in the NASA 757 research aircraft. The Controller Interface, using voice recognition and a touch screen for controller input, was tested at Atlanta Hartsfield Airport in August 1997.

Author (AIAA)

Controllers; Air Traffic Control; Data Links; Pilot Performance; Man Machine Systems

19980067792

Some ATC implications of introducing flight management system based routes in the terminal airspace

Schwartz, Jonathan, MITRE Corp., USA; Mundra, Anand, MITRE Corp., USA; Broderick, John, FAA, USA; Nash, Rudolph, FAA, USA; 1997, pp. 9.1-16 to 9.1-23; In English; Copyright; Avail: Aeroplus Dispatch

The availability of flight management system (FMS) equipment in the modern cockpit offers the possibility of introducing FMS-based routes in the terminal airspace. Introduction of such routes may offer significant workload reduction benefits for controllers and pilots. This paper studies some ATC issues and benefits associated with the introduction of FMS routes in the terminal airspace in the current ATC environment. A simple FMS route compatible with an existing constrained arrival flow at Baltimore-Washington International Airport (BWI) is studied through a computer simulation. The study investigates the effect of varying levels of FMS equipage and demonstrates that the use of FMS-based routes facilitates a reduction in controller/pilot communication and a consequent increase in airspace throughput. The study also shows that even in an environment of minimal complexity, the mixing of aircraft with and without FMS capabilities presents certain ATC issues. An operational solution to the issues is presented.

Author (AIAA)

Air Traffic Control; Flight Management Systems; Cockpits; Workloads (Psychophysiology)

19980067793

Evaluating the cost of ASM/ATFM measures

Kerlirzin, Philippe, CENA, France; Manchon, Serge, CENA, France; Plusquellec, Christine, CENA, France; 1997, pp. 9.1-24 to 9.1-31; In English; Copyright; Avail: Aeroplus Dispatch

Studies associated with air traffic management in support of French and European ATC in international cooperation are described. Emphasis is placed on the design and implementation of mock-ups and prototypes for airspace and air traffic flow managers.

Author (AIAA)

Air Traffic Control; Airspace; Cost Analysis

19980067795

Illustration of a broadcast architecture for flight information services

Flathers, G. W., II, MITRE Corp., USA; 1997, pp. 9.2-9 to 9.2-15; In English; Copyright; Avail: Aeroplus Dispatch

This paper illustrates the use of a broadcast data link architecture to disseminate information, such as text or graphical weather data; the status of airports, airspace, and facilities; and other operational information, to aircraft in flight. Provision of this type of information to the cockpit is called flight information services (FIS), and many studies conclude that having better access to such information helps the pilot make better in-flight decisions. Building upon this premise, this paper illustrates how a broadcast data link architecture could be used by different segments of the user community to service their in-flight FIS needs, and also shows how ground-based entities (e.g., airline dispatch offices, ATC facilities, pilot briefing desks, etc.) could benefit. A broadcast data link architecture, by virtue of its simplicity, performance, and operational suitability, offers an economically attractive approach to supporting FIS and is recommended as a cornerstone of the future NAS.

Author (AIAA)

Data Links; Airports; Broadcasting; Air Traffic Control; National Airspace System

19980067798

Design of a conflict detection algorithm for the Center-TRACON Automation System

Isaacson, Douglas R., NASA Ames Research Center, USA; Erzberger, Heinz, NASA Ames Research Center, USA; 1997, pp. 9.3-1 to 9.3-9; In English; Copyright; Avail: Aeroplus Dispatch

An algorithm for detecting and analyzing potential enroute conflicts has been designed and implemented within the Center-TRACON Automation System (CTAS). The design uses the 4D trajectories provided by CTAS to produce a set of probable future conflicts, and assists the enroute sector controller in efficiently resolving these conflicts. Conflicts are detected via comparisons of trajectories at closely spaced time instants, with measures taken to limit the computations required to complete the search. Performance tests indicate more than 800 aircraft can be processed by the conflict detection and analysis algorithm within a search cycle of 10 s. This suggests that the search algorithm easily meets the performance requirements for an automated conflict detection and resolution tool in the current air traffic system. The algorithm includes a trial resolution functionality which automatically detects conflicts of proposed resolutions, and gives near instantaneous feedback to controller input.

Author (AIAA)

Collision Avoidance; Automation; Air Traffic Control; Approach; Radar Tracking; Flight Paths

19980067799

Conflict resolution advisory service in Autonomous Aircraft Operations

Duong, Vu N., EUROCONTROL, Experimental Centre, France; Hoffman, Eric G., EUROCONTROL, Experimental Centre, France; 1997, pp. 9.3-10 to 9.3-17; In English; Copyright; Avail: Aeroplus Dispatch

We present the initial results obtained from the Autonomous Aircraft Operations study (FREER-1) that targets full delegation of ATC to aircraft operating in low-density airspace. Specific issues of Autonomous Aircraft Operations (AAO) supporting free-route, free flight and user-preferred routing are discussed. A description of the current prototype illustrating the Airborne Interactive Conflict Resolution Advisory service is included.

Author (AIAA)

Air Traffic Control; Navigation Aids; Surveillance; Telecommunication

19980067800

Using air-ground data link and operator-provided planning data to improve ATM decision support system performance

Wanke, Craig, MITRE Corp., USA; 1997, pp. 9.3-18 to 9.3-26; In English; Copyright; Avail: Aeroplus Dispatch

Decision support systems (DSS) are being developed for many air traffic management (ATM) applications. Examples include conflict detection, conflict resolution, evaluation of user reroute requests, and flow management. Improved prediction accuracy may enable development of more advanced ATM DSS, providing greater benefit to airspace users. This paper describes a study evaluating the use of two possible additional data sources to improve trajectory prediction: air-ground data link of aircraft speed and wind information, and additional flight planning information received from aircraft operators. Incorporation of air-ground data link reports into a prototype DSS was found to significantly improve trajectory prediction accuracy and stability. Work is under way on evaluating the prediction accuracy benefits of additional flight planning information.
Author (AIAA)
Ground-Air-Ground Communication; Decision Making; Flight Paths

19980067801

Medium term conflict detection for free routing - Operational concepts and requirements analysis

Warren, Anthony, Boeing Commercial Airplane Group, USA; 1997, pp. 9.3-27 to 9.3-34; In English
Contract(s)/Grant(s): NAS1-20267; Copyright; Avail: Aeroplus Dispatch

Next-generation air traffic management systems will provide automated, early detection of flight path separation conflicts for en-route aircraft. A primary objective of these systems is to provide medium-term (10-30-min) lookahead for early detection and resolution of separation conflicts, and for arrival and departure flow management at busy hub airports. This paper focuses on concepts for conflict probe system implementation and on engineering studies to specify CNS/ATM requirements in a free routing environment. Results of conflict probe sensitivity studies using Monte Carlo and covariance analysis are discussed. These studies demonstrate the value of modeling path prediction uncertainty and provide a means of allocating navigation, surveillance, and wind forecasting requirements to achieve desired conflict probe performance.
Author (AIAA)
Flight Paths; Prediction Analysis Techniques

19980067802

Assessment of the field trials, algorithmic performance, and benefits of the User Request Evaluation Tool (URET) conflict probe

Brudnicki, D. J., MITRE Corp., USA; Lindsay, K. S., MITRE Corp., USA; McFarland, A. L., MITRE Corp., USA; 1997, pp. 9.3-35 to 9.3-44; In English; Copyright; Avail: Aeroplus Dispatch

In order to respond to rising demands for services from NAS, the FAA and the MITRE Corporation’s Center for Advanced Aviation System Development (CAASD) have developed and evaluated a set of en route ATC decision support capabilities based on many of years of earlier work on the Advanced En Route ATC (AERA) program. The component capabilities, embodied in a prototype referred to as the User Request Evaluation Tool (URET), include a conflict probe that continuously checks current flight plan trajectories for strategic conflicts, and a trial planning function that allows a controller to expeditiously evaluate problem resolutions before they are issued as clearances. The URET prototype was deployed to the Indianapolis Air Route Traffic Control Center (ARTCC) for field trials in January 1996. The field trials have strongly indicated thus far that URET capabilities are operationally acceptable for both planning and clearance decision making purposes at the en route sector. This paper presents key findings from the field trials and from other related activities. It includes a summary of the field evaluation results, an algorithmic performance assessment of URET’s conflict probe and component capabilities, and a discussion of the projected benefits that can be expected with a national deployment of the system.
Author (AIAA)
National Airspace System; Air Traffic Control

19980067803

Medium term conflict detection in EATCHIP Phase III

Vink, Alex, EUROCONTROL, Belgium; Kauppinen, Seppo, EUROCONTROL, Belgium; Beers, Jos, National Aerospace Lab., Netherlands; de Jong, Koen, National Aerospace Lab., Netherlands; 1997, pp. 9.3-45 to 9.3-52; In English; Copyright; Avail: Aeroplus Dispatch

The EATCHIP Phase III functionality will include a number of advanced air traffic management tools: Conformance Monitoring and Controller Reminders, Arrival and Departure Management, Safety Nets (Short-Term Conflict Alert, Minimum Safe Altitude Warning) and Area Proximity Warning (APW), and Medium-Term Conflict Detection (MTCD), which is addressed in some detail in this presentation. EATCHIP Phase III ATC decision support tools will enable ATC to provide a better service by enabling: early detection of potential problems, timely advice on actions to be taken to prevent them, and alerts in cases of imminent collision risk. EUROCONTROL is also starting the development of EATCHIP Phase III trajectory prediction through a col-

laborative flight data processing project, through which a number of major players in European ATM will pool their knowledge and accommodate all aspirations on this subject. This paper gives background information on detection of conflicts in EATCHIP Phase III timeframe in Europe and a brief description of capabilities of the EATCHIP Phase III Medium-Term Conflict Detection tool.
Author (AIAA)
Air Traffic Control

19980067804

Surveillance monitoring of parallel precision approaches in a free flight environment

Evers, Carl, Rannoch Corp., USA; Hicok, Dan, Rannoch Corp., USA; Wong, Gene, FAA, USA; 1997, pp. 9.4-1 to 9.4-8; In English; Copyright; Avail: Aeroplus Dispatch

The FAA is conducting evaluations of Precision Runway Monitoring (PRM) surveillance techniques. This paper describes the evaluation results of the Multilateration/ADS-B system trials conducted at Atlanta-Hartsfield International Airport (ATL) in 1997. The performance of Time Difference of Arrival (TDOA) position multilateration of aircraft Mode S and Mode A/C transmissions was evaluated, in addition to the system's capability to support 1090 MHz ADS-B. The paper provides a system overview and presents preliminary coverage, accuracy, and update rate results.
Author (AIAA)
Surveillance; Aircraft Approach Spacing; Free Flight; Runway Conditions

19980067806

CDMA for communications in the aeronautical environment

Matolak, David W., MITRE Corp., USA; 1997, pp. 9.4-21 to 9.4-28; In English; Copyright; Avail: Aeroplus Dispatch

This work outlines the key attributes of CDMA communication systems, specifically, direct-sequence spread spectrum systems. We make only a brief comparison with more traditional multiple access schemes (TDMA and FDMA), and then describe direct-sequence CDMA modulation and demodulation for a simple transmitter and receiver in a single 'cell' environment. The CDMA waveform description yields expressions which allow estimation of system capacity - the number of simultaneously active channels the system can support. We include nonidealities such as additional (interfering) cells and imperfect power control. We review TDMA capacity expressions and show some comparative estimated capacity results for our VHF Air-Ground/Ground-Air application, using waveforms based on terrestrial cellular schemes.
Author (AIAA)
Code Division Multiple Access; Aeronautics; Time Division Multiple Access

19980067807

Estimation of TDMA and CDMA capacities for an air-to-ground communication system

Matolak, David W., MITRE Corp., USA; Smith, Steven L., MITRE Corp., USA; 1997, pp. 9.4-29 to 9.4-33; In English; Copyright; Avail: Aeroplus Dispatch

We estimate capacities of code-division multiple access (CDMA) and TDMA systems when applied to an air-to-ground/ground-to-air (AG/GA) environment. Our analysis is based upon a regular cellular arrangement of ground stations (bases), as in the land-mobile environment, and uses waveforms based on current cellular standards. Two of the most crucial parameters for capacity estimation, unique for the air-to-ground environment, are the outside-cell interference factor for CDMA and the frequency re-use factor for TDMA. These are computed, using a quasi-2D analysis, for average and worst-case conditions, taking into account radio propagation effects at VHF/UHF. We also investigate variations from conventional system operational modes: half-duplex for TDMA, and 1/3 frequency re-use for CDMA. We provide capacity estimates vs cell size, and show that (as in the cellular case), capacity depends on the many available system parameters in addition to cell size.
Author (AIAA)
Time Division Multiple Access; Ground-Air-Ground Communication; Code Division Multiple Access

19980067926

Evaluation of image-type glide slope performance in the presence of snow cover

Marcum, Frank, USA; IEEE Transactions on Aerospace and Electronic Systems; Jan. 1998; ISSN 0018-9251; Volume 34, no. 1, pp. 71-83; In English; Copyright; Avail: Aeroplus Dispatch

A formulation for the effects that the ground-reflected signal has on the far-field performance of image-type glide slope is developed using geometrical optics. The effects of snow cover are then related to the formulation and analyzed. Results indicate

that it is possible for certain types of dry snow to cause glide slope system performance to exceed U.S. Flight Inspection Manual tolerances at depths below existing FAA plowing criteria.
Author (AIAA)
Snow Cover; Far Fields; Geometrical Optics; Image Processing; Instrument Landing Systems; Signal Reflection

19980067940

Capacities of mobile air/ground radio communication systems employing cylindrical cells

Elnoubi, Said M., Alexandria Univ., Egypt; IEEE Transactions on Aerospace and Electronic Systems; Jan. 1998; ISSN 0018-9251; Volume 34, no. 1, pp. 247-256; In English; Copyright; Avail: Aeroplus Dispatch

Cylindrical cells represent actual service volumes used in terminal areas (airports) for ATC communications between pilots and ground controllers. The channel capacities of simplex and duplex frequency division multiplexing (FDM) mobile air/ground radio communication systems employing cylindrical cells are compared assuming a network of identical cylindrical cells and a dedicated radio channel per group of aircraft and its ground controller. The two systems are compared, with both cochannel and adjacent channel interferences for analog and digital modulation taken into consideration. Capacities of duplex FDM and code division multiplexing (CDM) are compared under the same assumptions for digital modulation. This work shows that the capacity ratio of duplex and simplex FDM systems depends on the cell dimensions. It also shows that when ATC requirements are taken into consideration, FDM provides a higher capacity than CDM for all the cell-dimension ranges considered.
Author (AIAA)
Ground-Air-Ground Communication; Air Traffic Control; Radio Communication

19980067943

Biased PNG law for impact with angular constraint

Kim, Byung S., Seoul National Univ., Republic of Korea; Lee, Jang G., Seoul National Univ., Republic of Korea; Han, Hyung S., Soonchunhyang Univ., Republic of Korea; IEEE Transactions on Aerospace and Electronic Systems; Jan. 1998; ISSN 0018-9251; Volume 34, no. 1, pp. 277-288; In English; Copyright; Avail: Aeroplus Dispatch

A new homing guidance law is proposed to impact a target with a desired attitude angle. It is a variation of the conventional proportional navigation guidance (PNG) law which includes a supplementary time-varying bias. The proposed guidance law does not require a time-to-go estimation and has a simpler form. Analytic conditions for fulfilling the guidance goal are also provided. Simulation results demonstrate that the proposed guidance law has wider launch envelopes than the previous one and shows good performance even against a maneuvering target.
Author (AIAA)
Homing Devices; Guidance (Motion)

19980067949

Effect in range difference position estimation due to stations' position errors

Manolakis, Dimitris E., Salonika, Technical Education Inst., Greece; Cox, Maurice E., SATSYSS, UK; IEEE Transactions on Aerospace and Electronic Systems; Jan. 1998; ISSN 0018-9251; Volume 34, no. 1, pp. 329-334; In English; Copyright; Avail: Aeroplus Dispatch

This work addresses the subject of systematic errors caused by using incorrect coordinates for the sites where the stations are located in a 3D aircraft position estimation system composed of one transmitter/receiver and three receiving stations. The differences in the aircraft ranges from the receiving stations are used to derive the position estimate. A general analytic expression is developed to assess the error resulting from using erroneous coordinates for the receiver's location. Evaluation has been performed for certain representative conditions.
Author (AIAA)
Position Errors; Error Analysis; Three Dimensional Models; Flight Paths; Height

19980068299

Incorporation of orbital dynamics to improve wide-area differential GPS

Ceva, Juan, Stanford Univ., USA; Parkinson, Bradford, Stanford Univ., USA; Bertiger, Willy, JPL, USA; Muellerschoen, Ronald, JPL, USA; Yunck, Thomas, JPL, USA; Navigation; 1997; ISSN 0028-1522; Volume 44, no. 2, pp. 171-180; In English
Contract(s)/Grant(s): NAS8-36125; FAA-93-G-004; Copyright; Avail: Aeroplus Dispatch

A powerful dynamical technique for computing precise GPS satellite orbits for the FAA's Wide-Area Augmentation System (WAAS) has been evaluated. This method yields more accurate and robust orbit solutions than nondynamical approaches, while enabling complete separation of orbit and satellite clock errors for reliable integrity monitoring. Experimental results with real

data show that a network of 13 monitor stations distributed over North America, producing dual-frequency pseudorange data, yields orbit accuracies a factor of 3 better than current broadcast orbits within the service volume. WAAS simulations comparing orbit solutions and user positioning results obtained with the broadcast, dynamical, and nondynamical orbits are presented. The dynamical orbit estimation technique produces the most accurate user results. The tests show that dynamical orbit estimation and the slow correction computation are easily achievable in the real-time WAAS scenario.
Author (AIAA)
Global Positioning System; Satellite Orbits

19980068303

DGPS kinematic carrier phase signal simulation analysis for precise velocity and position determination

Cannon, M. E., Calgary, Univ., Canada; Lachapelle, Gerard, Calgary, Univ., Canada; Szarmes, Michael C., Calgary, Univ., Canada; Hebert, Jeffrey M., USAF, USA; Keith, James, USAF, USA; Jokerst, Scott, USAF, USA; Navigation; 1997; ISSN 0028-1522; Volume 44, no. 2, pp. 231-245; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the differential GPS and signal simulator equipment, procedures, and simulated aircraft trajectories used to analyze carrier phase measurements in estimating velocities and 3D positions. A differential GPS simulator system was used to generate C/A-code, P-code, and carrier phase signals from segments of the actual GPS constellation. Two pairs of dual-frequency receivers from different manufacturers were tested. These units have the capability of tracking the P-code (L1/L2 for one of the receivers and L2 for the other). An aircraft trajectory with accelerations up to 5 g was simulated, and analysis is performed in terms of the resulting velocity errors and dynamics. Two methods for estimating the 3D velocities were tested, namely carrier phase with fixed-integer and real-number (float) ambiguities. Both raw Doppler measurements and a number of carrier-phase-derived Doppler measurements were tested. As a by-product, the 3D positions could also be determined using various carrier phase approaches. The estimated quantities were compared with the reference quantities known a priori to determine the performance of the receivers under the various conditions simulated.
Author (AIAA)
Signal Analysis; Orbital Position Estimation; Velocity Measurement; Inertial Navigation; Aircraft Communication

19980068572

Pseudo flight test

Eden, Dayton D., Intelligent Machine Technology Corp., USA; McKinley, Michael C., Intelligent Machine Technology Corp., USA; Sundstrom, Bryce M., USAF, Wright Lab., USA; Belcher, Byron W., USAF, Wright Lab., USA; Smith, Roger M., USAF, Wright Lab., USA; 1997, pp. 194-205; In English
Contract(s)/Grant(s): F08630-96-C-0091; Copyright; Avail: Aeroplus Dispatch

The Air Force program, Smart Tactical Autonomous Guidance (STAG), has as its central concept the use of passive millimeter wave (PMMW) imagery to enable an autonomous vehicle to perform its own smart guidance and attack. The results of a natural-imagery feasibility program will be reported, aimed at validating the STAG approach. PMMW imagery will be taken from land-based vantage points that mimic the geometry of an airborne, downlooking sensor. Essentially, hardware-in-the-loop simulation will be performed, where PMMW data will be real, and the loop extends over many miles of outdoor terrain. All imagery will be gathered using frame times consistent with existing camera capabilities. Image flow and other data processing will be done off-line. The key ingredients will be the sequences of imagery and the computer processing of that imagery. The means for accomplishing both have been developed under the STAG program. The camera to be used operates at W-band and consists of an f/1, refractive, telecentric, image forming system with a 30 cm diameter input aperture. Image flow involves a model whose parameters are determined via automated pixel tracking from frame to frame. Passive range maps are then generated, and navigation is accomplished through the subsequent correlation of these maps with reference elevation maps.
Author (AIAA)
Flight Tests; Millimeter Waves; Microwave Imagery

19980068639

Autonomous Landing Guidance system validation

Bui, Long, Lear Astronics Corp., USA; Franklin, Mike, Lear Astronics Corp., USA; Taylor, Christopher, Lear Astronics Corp., USA; Neilson, Graham, Lear Astronics Corp., USA; 1997, pp. 19-25; In English; Copyright; Avail: Aeroplus Dispatch

The Autonomous Landing Guidance (ALG) is a combination of raster imaging sensors, head-up displays, flight guidance and procedures which allow pilots to maneuver in adverse weather, at night, or in low visibility conditions at facilities with minimal or no ground aids. Maneuvers in the context of ALG relate to takeoff, landing, rollout, taxi and terminal parking. Commercial needs are driven by potential revenue savings since today only 43 Type III and 80 Type II Instrumented Landing System (ILS)

runways in the U.S. are equipped for lower minimum flight operations; most of these ILS facilities are clustered at major gateway airports, which further impacts on dispatch authority and general ATC regional delays. Infrastructure costs to upgrade additional runways must account for the installation of lights and markers mandated for Cat III operations. Recently, Lear Astronics, in cooperation with consortium members of the ALG Program, concluded a flight test program which evaluated the utility of the ALG system in meeting both civil and military needs. Those results are the subject of this paper.
Author (AIAA)
Autonomous Navigation; Landing Aids; Airborne Radar; Imaging Radar

19980068640
Landmark navigation and autonomous landing approach with obstacle detection for aircraft
Fuerst, Simon, Muenchen, Univ. der Bundeswehr, Germany; Werner, Stefan, Muenchen, Univ. der Bundeswehr, Germany; Dickmanns, Dirk, Muenchen, Univ. der Bundeswehr, Germany; Dickmanns, Ernst-Dieter, Muenchen, Univ. der Bundeswehr, Germany; 1997, pp. 28-39; In English; Copyright; Avail: Aeroplus Dispatch

A machine perception system for aircraft and helicopters using multiple sensor data for state estimation is presented. by combining conventional aircraft sensors like gyros, accelerometers, artificial horizon, aerodynamic measuring devices and GPS with vision data taken by conventional CCD-cameras mounted on a pan-and-tilt-platform, the position of the craft can be determined as well as the relative position to runways and natural landmarks. The vision data of natural landmarks are used to improve position estimates during autonomous missions. A built-in landmark management module decides which landmark should be focused on by the vision system, depending on the distance to the landmark and the aspect conditions. More complex landmarks are modeled with different levels of detail that are activated according to range. A supervisor process compares vision data and GPS data to detect mistracking of the vision system due to poor visibility, and tries to reinitialize the vision system or to set focus on another landmark available. During landing approach obstacles like trucks and airplanes can be detected on the runway. The system has been tested in real-time within a hardware-in-the-loop simulation. Simulated aircraft measurements corrupted by noise and other characteristic sensor errors have been fed into the machine perception system. Results from real-time simulation runs are given.
Author (AIAA)
Autonomous Navigation; Aircraft Landing; Landing Aids; Collision Avoidance; Landmarks; Computer Vision; Approach

19980069079
SPSA/SIMMOD optimization of air traffic delay cost
Kleinman, Nathan L., Brigham Young Univ., USA; Hill, Stacy D., Johns Hopkins Univ., APL, USA; Ilenda, Victor A., Johns Hopkins Univ., APL, USA; 1997, pp. 1121-1125; In English
Contract(s)/Grant(s): N00039-95-C-0002; Copyright; Avail: Aeroplus Dispatch

The cost of delay is a serious and increasing problem in the airline industry. Air travel is increasing and domestic airports already incur thousands of hours of delay daily, costing the industry $2 billion a year. One strategy for reducing total delay costs is to hold planes for a short time at the gate in order to reduce costly airborne congestion. In a network of airports involving hundreds of flights, it is difficult to determine the amount to hold each flight at the gate. This paper discusses how the optimization procedure simultaneous perturbation stochastic approximation (SPSA) can be used to process delay cost measurements from air traffic simulation packages and produce an optimal gate holding schedule. As a test case, the SIMMOD air traffic simulation package was used to model a simple four-airport network. Initial delay costs are reduced up to 10.3 percent.
Author (AIAA)
Air Traffic; Time Lag; Cost Analysis; Stochastic Processes; Perturbation Theory; Optimization

19980069080
Computationally efficient conflict detection methods for air traffic management
Sridhar, B., NASA Ames Research Center, USA; Chatterji, G. B., NASA Ames Research Center, USA; 1997, pp. 1126-1130; In English; Copyright; Avail: Aeroplus Dispatch

This paper takes a detailed look at the standard approach to conflict detection in air traffic management in order to reduce the number of computations. The number of computations are reduced by posing the conflict detection problem in two steps: (1) spatial separation and (2) temporal separation. Three algorithms for conflict detection are described. The first method describes the standard approach. It computes the Euclidean distance between all aircraft pairs and compares the distance to the allowable minimum separation distance. The number of computations required by this method are of the order of n-squared where n is the number of aircraft. The second algorithm transforms the planned trajectories of the aircraft into a sequence of discrete spatial regions which are then sorted to locate regions in airspace where conflict is possible. The number of computations in this case are of the order of n log2 n. The third algorithm uses an accumulator driven by the transformed trajectories to locate regions where

conflict is possible. It is shown that the computational complexity of this algorithm is of the order of n. Algorithmic details of the sorting-based and accumulator-based algorithms are provided. Numerical examples are presented to demonstrate the theoretical computational advantage of using the sorting-based and accumulator-based conflict detection algorithms over the standard method.
Author (AIAA)
Air Traffic Control; Aircraft Approach Spacing

19980069472

Mountain Top - Beyond-the-horizon cruise missile defense

Zinger, William H., Johns Hopkins Univ., USA; Krill, Jerry A., Johns Hopkins Univ., USA; Johns Hopkins APL Technical Digest; Dec. 1997; ISSN 0270-5214; Volume 18, no. 4, pp. 501-520; In English; Copyright; Avail: Aeroplus Dispatch

The Cruise Missile Defense Advanced Concept Technology Demonstration, known as Mountain Top, was successfully completed at Kauai, Hawaii, during January and February 1996. The demonstration featured a new type of cooperative engagement known as ’forward pass’, made possible by the Cooperative Engagement Capability, in which low-flying drones were engaged beyond the horizon of an Aegis ship for greatly increased engagement range. Although the Navy performed the forward pass cooperative engagements alone, the Marine Corps, Air Force, and Army participated in other major joint-services exercises. Most significantly, the concept of a surface-launched, air-supported engagement of cruise missiles was validated and has provided the impetus for follow-on joint-services pursuit of an extended, beyond-the-horizon engagement capability for defense of land sites from land-, air-, and sea-based missile defense systems. This article describes the background, objectives, conduct, and results of the Mountain Top test operations. Also detailed are the systems engineering concepts, system configurations, and the test and evaluation process that went into the planning, conduct, and analysis of the many complex experiments of the Advanced Concept Technology Demonstration.
Author (AIAA)
Cruise Missiles; Missile Defense; Missile Tests

19980070138

Comparative performance characteristics of half-wave and one-wave wall radomes *SRavnitel’nye radiotekhnicheskie kharakteristiki antennykh obtekatelej ’poluvolnovoj’ i ’volnovoj’ konstruktsij*

Minokin, L. M., Russia; Radiotekhnika i Ehlektronika; May 1997; ISSN 0033-8494; Volume 42, no. 5, pp. 559-562; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of calculations and experimental data are presented for radomes with half-wave and one-wave wall thickness. The good agreement between the two sets of data indicates that the mathematical models developed here can be used for predicting the performance characteristics of radomes. It is also shown that one-wave wall radomes are suitable for flight vehicle applications.
AIAA
Radar Antennas; Antenna Arrays; Antenna Design; Dielectrics; Electromagnetic Fields; Wave Diffraction

19980071970

The Future Air Navigation System (FANS) -Communication navigation surveillance air traffic management

Galotti, Vincent P., Jr., ICAO, Canada; 1997; In English; ISBN 0-291-39833-2; Copyright; Avail: Aeroplus Dispatch

A concept for a future navigation system that would meet the needs of civil aviation in the 21st century is reviewed. The concept, known as the Future Air Navigation System (FANS) Communications, Navigation, Surveillance/Air Traffic Management (CNS/ATM) systems concept, is based on a complex and interrelated set of technologies, dependent mainly on satellites. A historical perspective is first presented; the discussion then focuses on many of the technical and other aspects of the CNS/ATM systems concept, including institutional, economic, and human factors aspects.
AIAA
Air Navigation; Technological Forecasting

19980072315

Airport communications network of the future will probably be based on fibre-optic cables

Ianace, Peter E., USA; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 17, 18; In English; Copyright; Avail: Aeroplus Dispatch

Using fiber-optic cable in place of copper, airports can implement an integrated communications network that handles air traffic control and various commercial airport operations. The advantages of an integrated network include simplified management and maintenance, lower costs, and faster communications.
Author (AIAA)
Airports; Communication Networks; Fiber Optics; Communication Cables; Air Traffic Control; Airport Planning

19980072368
New and envisioned communication technologies - How well can they support future air traffic management operations?
Sarter, Nadine B., Illinois, Univ., Savoy, USA; Woods, David D., Ohio State Univ., Columbus; 1997, pp. 238-242; In English; Copyright; Avail: Aeroplus Dispatch

A recent line of research explored the ability of two communication systems - DataLink and the Voice Control and Switching System (VSCS) - to handle communication not only in the current ATC system but to also support the highly flexible operations and new coordination and knowledge demands that are likely going to be part of the future ATM system. System reviews, conceptual simulations, and a pilot survey served to gather information on current and potential future experiences with these systems. The results of our research suggest that neither system is tailored to future ATM operations, and that they create new challenges even in the context of the current system.
Author (AIAA)
Technological Forecasting; Technology Utilization; Air Traffic Control; Technology Assessment

19980072462
Rapid growth in Chinese air traffic
Laven, Tony, IATA, Thailand; Airport technology international 1998; 1997, pp. 57, 58; In English; Copyright; Avail: Aeroplus Dispatch

Sustained growth in Chinese civil aviation will soon outstrip the capacity of China’s conventional air traffic system. The early implementation of the new Communications, Navigation, Surveillance/Air Traffic Management (CNS/ATM) system to remedy the situation is discussed.
AIAA
Air Traffic; China; Satellite Navigation Systems; Global Positioning System; Flight Management Systems

19980072463
Air traffic control at Bordeaux
Fitzsimons, Bernard, UK; Airport technology international 1998; 1997, pp. 61, 62; In English; Copyright; Avail: Aeroplus Dispatch

The application of the PHARE (Programme for Harmonised Air Traffic Maangement Research in Europe) to ATC at Bordeaux Airport is considered. The contribution that the new control tower, technical block, and eventually a new second runway will make to ATC at the airport is addressed.
AIAA
Air Traffic Control; Passengers; France

19980072472
Study of an automatic landing system of a pilotless aircraft
Xu, Tingxue, Naval Aeronautical Engineering Academy, China; Cao, Yunfeng, Nanjing Univ. of Aeronautics and Astronautics, China; Luo, Feng, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Oct. 1997; ISSN 1005-2615; Volume 29, no. 5, pp. 523-528; In Chinese; Copyright; Avail: Aeroplus Dispatch

The paper deals with the analysis and research of the automatic landing system of a pilotless aircraft. After describing the overall plan for the automatic landing system of a pilotless aircraft with DGPS/SINS/RA combination guidance and trajectory control, the system is analyzed and designed using small disturbance equations. With nonlinear equations of the pilotless aircraft and different initial states as well as various disturbances, the automatic landing process is simulated without speed control. Simulation results show that the requirements for the landing characteristics can be fully met.
Author (AIAA)
Pilotless Aircraft; Aircraft Landing; Automatic Landing Control

19980072588

The integrated INS/SAR navigation system aided by terrain signal

Chen, Yuxin, Northwestern Polytechnical Univ., China; An, Dong, Northwestern Polytechnical Univ., China; Ren, Sicong, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 598-602; In Chinese; Copyright; Avail: Aeroplus Dispatch

The terrain-aided navigation techniques of elevation correlation are employed in the integrated INS/SAR navigation system, and we obtain a new type of integrated navigation system possessing high accuracy, good autonomy, and wide adaptability. In this paper, the picture and elevation correlation concepts and the key techniques needed for realizing this system are discussed. Simulation results show that this integrated navigation system performs well. When using a low-precision inertial navigation system, this kind of system can still obtain a location error of less than 4m, which is higher than the precision attainable with GPS P code. Moreover, the INS/SAR integrated navigation system aided by terrain signal is completely autonomous and its reliability is also very much improved.

Author (AIAA)

Inertial Navigation; Synthetic Aperture Radar; Terrain Analysis

19980073125 Federal Aviation Administration, Washington, DC USA

Facility Operation and Administration (7210.3P)

Feb. 26, 1998; 428p; In English

Report No.(s): PB98-128960; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This order provides direction and guidance for the day to day operation of facilities and offices under the administrative jurisdiction of the Federal Aviation Administration’s Director of Air Traffic.

NTIS

Air Traffic Control; Air Traffic; Guidance (Motion)

19980073183 Federal Aviation Administration, Washington, DC USA

Flight Services (7110.10M)

Feb. 26, 1998; 336p; In English

Report No.(s): PB98-130628; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

This order prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services. Controllers are required to be familiar with the provisions of this order that pertain to their operational responsibilities and to exercise their best judgement if they encounter situations not covered by it.

NTIS

Air Traffic Control; Terminology; Procedures; Controllers

19980073184 Federal Aviation Administration, Washington, DC USA

Air Traffic Control (7110.65L)

Feb. 26, 1998; 562p; In English

Report No.(s): PB98-130636; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

This order prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services. Controllers are required to be familiar with the provisions of this order that pertain to their operational responsibilities and to exercise their best judgement if they encounter situations not covered by it.

NTIS

Air Traffic Control; Terminology; Procedures; Controllers

Includes aircraft simulation technology.

19980049052

Flamingo - Long endurance high altitude UAV

Alperovitch, Arkady, Technion - Israel Inst. of Technology, Haifa, Israel; Ardatz, Sorin, Technion - Israel Inst. of Technology, Haifa; Ben-Micha, Yariv, Technion - Israel Inst. of Technology, Haifa; Dotan, Nevo, Technion - Israel Inst. of Technology, Haifa; Gal, Ofer, Technion - Israel Inst. of Technology, Haifa; Gershengoren, Arie, Technion - Israel Inst. of Technology, Haifa; Kanevsky, Dmitry, Technion - Israel Inst. of Technology, Haifa; Snir, Amir, Technion - Israel Inst. of Technology, Haifa; Veksler, Igor, Technion - Israel Inst. of Technology, Haifa; 1998, pp. 344-355; In English; Copyright; Avail: Aeroplus Dispatch

The Flamingo project is dedicated to the development of an Unmanned Air Vehicle (UAV) tasked to perform more than 24 hours endurance missions over targets at strategic ranges, while loitering at altitudes above 60 kft. The flamingo carries a 1000 lb payload and maintains cruise speeds of 0.5-0.6 Mach. The development team was composed of nine senior Aeronautical Engineering students at the Haifa Institute of Technology in Israel. The team was assigned to develop a UAV within a short period of time, and therefore existing technologies and currently available mature subsystems, such as payloads, avionics, data-link, and engines, were used. The goals to meet low production and life cycle costs with high maintainability and mission availability were weighted as the most significant factors. A conventional fuselage-wing-tail configuration was selected in order to reduce developmental risk and to increase the probability of completing the program successfully. A highly efficient configuration was tailored with a high aspect ratio wing using optimization techniques to maximize L/D (32.5) and minimize the thrust required for flight at 60 kft. A composite material structure was used for weight reduction and for increased strength. A single engine configuration using a Williams Intl. FJ44-2 turbofan engine was selected to supply the required thrust and to reduce cost.

Author (AIAA)

Pilotless Aircraft; Airspeed; Life Cycle Costs; Aircraft Design; Aerodynamic Configurations

19980049157

Concept design of rotor blades of the WZ-1 helicopter

Wang, Huaming, Nanjing Univ. of Aeronautics and Astronautics, China; Peng, Ninghang, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 693-698; In Chinese; Copyright; Avail: Aeroplus Dispatch

The WZ-1 helicopter is a remote-controlled pilotless helicopter. In this paper, the general requirements of the helicopter's main rotor blade are introduced in respect of aerodynamics, dynamics, and structure. The effect of rotor blade configuration on helicopter performance, rotor aerodynamics, and dynamics of the WZ-1 helicopter is addressed. The parameters and configuration of WZ-1 helicopter rotor blades are given.

Author (AIAA)

Helicopter Design; Rotary Wings; Rotor Blades; Pilotless Aircraft; Remotely Piloted Vehicles; Rotor Aerodynamics

19980049160

New developments in helicopter technology

Zhang, Chenglin, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 607-614; In Chinese; Copyright; Avail: Aeroplus Dispatch

This paper briefly introduces new trends and achievements of helicopter technology in recent years, including a new rotor hub technique, optimization of blade aerodynamic performance, new styles of antitorque systems such as duct fan and NOTAR, a new technique of helicopter vibration control such as higher harmonic control (HHC), active control of structural response (ACSR) and actively controlled flap (ACF), and application of composites on helicopters. The paper lays stress on characteristics of new technology and development and application.

Author (AIAA)

Helicopter Performance; Technology Assessment; Harmonic Control; Rotor Blades; Aerodynamic Characteristics

19980049286

An experimental optimization of a protective coating for main/tail rotor blades of IAF helicopters

Fiszel, D., Israeli Air Force, Israel; Barda, O., Israeli Air Force, Israel; Shapira, D., Israeli Air Force, Israel; Schur, D., Israeli Air Force, Israel; 1998, pp. Appendix, p. 33-38; In English; Copyright; Avail: Aeroplus Dispatch

An experimental study was conducted at IAF facilities in order to optimize a special protective coating for helicopter blade leading edge. The experiment was based on examination of small scale models of protective coatings, and each coating was subjected to salt and humidity environments. Finally, from each model, a peal strength model was made and tested to examine the strength of each type of coatings. The experimental goals did not include a life cycle cost analysis, which was conducted after all results were analyzed first due to the significant costs involved in implementation of each type of coating that was examined.
Author (AIAA)
Helicopter Tail Rotors; Helicopter Design; Rotor Blades; Protective Coatings; Leading Edges; Polymeric Films

19980049643

Smart rotor - A new approach with remarkable potential for helicopter vibration reduction

Bai, Jingzhao, Nanjing Univ. of Aeronautics and Astronautics, China; Gu, Zhongquan, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 615-620; In Chinese; Copyright; Avail: Aeroplus Dispatch

The smart rotor using an actively controlled trailing edge flap (ACF) for vibration reduction is a new research topic to which more and more attention is being paid in helicopter engineering. This paper reviews the state of the art of this technology and the basic problems of vibration reduction using the actively controlled flap. It appears that the actively controlled flap has remarkable potential for helicopter vibration reduction together with excellent prospects of application.
Author (AIAA)
Helicopter Design; Smart Structures; Vibration Damping; Rotor Blades; Active Control; Trailing Edge Flaps

19980049650

Main load research on a remote pilotless helicopter design

Xiao, Qiuting, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 660-665; In Chinese; Copyright; Avail: Aeroplus Dispatch

Some problems of main load research on a remote pilotless helicopter (RPH) are considered, including design specifications, static strength load, dynamic characteristics and response, and landing load. Applications to load problems are discussed with reference to research on design specifications. Calculation of frame structural strength and static testing of frame strength and rigidity are discussed with reference to research on static strength loads. Frame vibration and response characteristics were examined by calculating and testing the dynamic characteristics and measuring the vibration level. Via calculation and falling vibration test for a ski-landing set, the characteristics of landing load were considered.
Author (AIAA)
Helicopter Design; Pilotless Aircraft; Aerodynamic Loads; Remotely Piloted Vehicles; Static Stability

19980049651

Analyses of torsional vibration characteristics for a helicopter transmission system

Gu, Zhongquan, Nanjing Univ. of Aeronautics and Astronautics, China; Yang, Jinxin, CAVC, Factory No. 120, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 674-678; In Chinese; Copyright; Avail: Aeroplus Dispatch

Torsional vibration of a transmission system is a dynamic problem which should be considered in the helicopter research and development stage. Using an analytical calculation the paper answered the following question: Do new hydraulic pumps and alternating-current genarators have a harmful effect on the torsional vibration characteristics of transmission chains of a revised type helicopter? In this paper, the dynamic stiffness matching method is used for analyses by which the expressions for the dynamic stiffness of subsystems are derived. The torsional vibration characteristics of the transmission system for a revised type helicopter are analyzed and compared to the results of the original helicopter.
Author (AIAA)
Helicopter Design; Transmissions (Machine Elements); Torsional Vibration; Impedance Matching

19980049654

Experimental research on the adaptive rotor blade model of a helicopter

Chen, Renwen, Nanjing Univ. of Aeronautics and Astronautics, China; Tao, Baoqi, Nanjing Univ. of Aeronautics and Astronautics, China; Xiong, Ke, Nanjing Univ. of Aeronautics and Astronautics, China; Jin, Jiang, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 699-703; In Chinese; Copyright; Avail: Aeroplus Dispatch

The adaptive control system of a helicopter rotor blade is an important technique in future advanced composite helicopters. It has many advantages over traditional rotor blades because it controls the flight of the helicopter without blade pitch and swash plate. In this paper, a typical model which intimates the blade of a helicopter is designed. Exciting the model with piezoceramics will result in a torsional deformation. This paper examines the mechanical properties of piezoceramics as an actuator.
Author (AIAA)
Helicopter Design; Rotary Wings; Adaptive Control; Rotor Blades; Aircraft Models

19980049655

Experimental investigation of the influence of rotor solidity on hover efficiency

Chen, Weiqin, Nanjing Univ. of Aeronautics and Astronautics, China; Sun, Jun, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 704-707; In Chinese; Copyright; Avail: Aeroplus Dispatch

Rotor solidity is an important parameter in helicopter design. An experimental investigation of the influence of rotor solidity on the figure of merit is conducted on a rotor test stand. The relationship between the rotor solidity and the figure of merit is analyzed. The experimental facilities and method are described. On the basis of the test results, the variations of the figure of merit with the collective pitch, the rotor thrust coefficient, and the rotor thrust coefficient per unit blade area are emphatically analyzed, and the influence of rotor solidity on the figure of merit is examined.
Author (AIAA)
Helicopter Design; Rotary Wings; Rotor Aerodynamics

19980049683

Design studies for a 200-seat aircraft

Wilson, Richard A. L., Defence Evaluation and Research Agency, UK; Aerospace Engineering; Mar. 1998; ISSN 0736-2536; Volume 18, no. 3, pp. 24-28; In English; Copyright; Avail: Aeroplus Dispatch

The two key configuration issues that must be addressed when designing a 200-seat aircraft are the use of narrow- or wide-body fuselage cross sections and the incorporation of growth potential so that derivative aircraft with increase payload (240 seats) can be developed. Here, the technique used by engineers at the Defense Evaluation and Research Agency (DERA) in the U.K for conceptual aircraft design is described. The approach is based on the development of a set of relationships to synthesize the type of aircraft to be studied, in this case high-subsonic transport aircraft. These are combined with multivariate optimization (MVO) routines to form the CIVIL MVO code. This method enables key design parameters to be optimized to meet a set of mission requirements. The optimized configuration must also satisfy a set of constraint functions to ensure aircraft safety and feasibility.
AIAA
Fuselages; Aircraft Design; Transport Aircraft; Commercial Aircraft; General Aviation Aircraft

19980050550

Designing aircraft structures to avoid multi-site damage failures

Brot, A., Israel Aircraft Industries, Ltd., Lod, Israel; 1998, pp. 171-179; In English; Copyright; Avail: Aeroplus Dispatch

A parametric study was performed on a potential multi-site damage aircraft structure. The effects of the pitch/diameter ratio, number of fastener rows, NDI method, and inspection intervals were considered. The parametric study was performed using the INSIM computer program which simulates the fatigue and inspection process. Five design configurations are recommended with the aim of minimizing the probability of failure of the multi-site damage structure.
Author (AIAA)
Aircraft Design; Aircraft Structures; Fatigue Life; Structural Failure; Short Cracks

19980050552

Non-linear design loads for maneuvering elastic aircraft

Raveh, D. E., Technion - Israel Inst. of Technology, Haifa, Israel; Karpel, M., Technion - Israel Inst. of Technology, Haifa; Yaniv, S., IMI, Israel; 1998, pp. 150-160; In English; Copyright; Avail: Aeroplus Dispatch

An efficient approach to analyze flexible aircraft maneuver loads, based on nonlinear aerodynamic theory, is described. It combines a Euler/Navier-Stokes aerodynamic method with a modal structural finite element model to obtain the aerodynamic load distribution on the free flying aircraft. Since the objective of the proposed aeroelastic analysis is to provide airloads for design, a general approach is taken that accounts for the effects of trim variables, such as angle of attack, control surfaces deflections, aircraft angular rates and accelerations, and the effect of the elastic deformations on the load distribution. In the proposed scheme, the trim solution is achieved during steady-state flow field convergence. This is done by occasionally interrupting the convergence

process, applying structural elastic deformations and trim corrections. It is shown that the total number of iterations required for flow-field convergence of the elastic configuration is typically almost identical to that of the rigid configuration. Being based on modal structural matrices, that are computed by a finite-element code, the CPU time required for the aerodynamic shape update, following an elastic deformation, is negligible. The method is demonstrated with a realistic wing-fuselage-elevator transport aircraft model maneuvering at Mach 0.85.
Author (AIAA)
Aircraft Design; Aircraft Maneuvers; Aeroelasticity; Aerodynamic Loads; Finite Element Method

19980050553

Galaxy composite structures - Certification methodology

Ghilai, G., IAI Engineering Center, Israel; David, A., IAI Engineering Center, Israel; Reisel, P., IAI Engineering Center, Israel; 1998, pp. 145-149; In English; Copyright; Avail: Aeroplus Dispatch

Israel Aircraft Industries (IAD) has used composite materials for primary and secondary aircraft parts for many years and has developed the methodology needed to substantiate their use in commercial and military aircraft. IAI is presently developing the Galaxy executive jet which includes composite parts. Most of the structures are considered as secondary parts, substantiated by analysis only. The ailerons and winglets are substantiated by similarity to the Astra/SPX jet. The rudder and the elevators, designed specially for the Galaxy, are considered as primary parts. The procedure used for the certification of these structures is shown schematically.
Author (AIAA)
Commercial Aircraft; Aircraft Parts; Composite Structures; Aircraft Design; Composite Materials; Military Aircraft

19980050557

A hybrid high altitude long endurance RPV

Harmats, M., Technion - Israel Inst. of Technology, Haifa, Israel; Weihs, D., Technion - Israel Inst. of Technology, Haifa; 1998, pp. 82-96; In English; Copyright; Avail: Aeroplus Dispatch

The feasibility of combining solar and internal combustion propulsion in propeller driven remote piloted vehicles (RPV) is considered. Solar energy, converted by photovoltaic cells, is used to drive electric motors during hours of daylight while turbocharged internal combustion engines are used during hours of darkness. The purpose of this combination is to obtain a reasonably sized vehicle (compared to a pure solar-propelled vehicle) at the expense of limiting endurance. A sizing study of the hybrid-propulsion RPV for given payload and maximal endurance was performed. Optimization of RPV aerodynamic configuration and weight distribution, propeller configuration, and cruise velocity was performed, and a novel daytime extra solar energy storage method is presented. For a 100 kg/500 W payload and required endurance of seven days at 32 deg north latitude, a 1000 kg RPV, with a wingspan of 39 m was obtained. The design includes four propellers, 5 m in diameter, each driven by a combination of a 4 HP electric motor and a 4 HP internal combustion engine. 90 percent of the top wing surface is covered by solar cells, which supply 20-40 percent of daily RPV requirements, depending on the season of the year.
Author (AIAA)
Remotely Piloted Vehicles; High Altitude; Solar Energy Conversion; Propeller Efficiency; Internal Combustion Engines

19980050558

Geometric CAD applications in aircraft design

Klunover, A., Israel Aircraft Industries, Ltd., Lod, Israel; Hoffman, S., Israel Aircraft Industries, Ltd., Lod; 1998, pp. 76-81; In English; Copyright; Avail: Aeroplus Dispatch

During the last few years new CAGD methods have been applied more and more within the process of aircraft design. The aircraft structures consist mainly of different types of airframes. The airframe geometry is derived from free-form surfaces which define the external shape of the aircraft. Designing the airframe structure requires specific advanced geometrical CAD capabilities, especially when one wants to take advantage of solid modeling, parametric and feature-based technologies. The current paper presents Israel Aircraft Industries (IAI) experience in three major CAGD applications: surface modeling, parametric and feature-based modeling of airframes, and mesh generation for structural analysis FEM. Accomplishments as well as fundamental problems are presented.
Author (AIAA)
Aircraft Design; Computer Aided Design; Aircraft Configurations; Airframes; Aircraft Models; Grid Generation (Mathematics)

19980050983

Global Hawk begins flight test program

Dornheim, Michael A., USA; Aviation Week & Space Technology; Mar. 09, 1998; ISSN 0005-2175; Volume 148, no. 10, pp. 22, 23; In English; Copyright; Avail: Aeroplus Dispatch

DARPA's Global Hawk high altitude reconnaissance UAV, which is as large as a business jet and designed for high endurance missions with 1900 lbs of sensors, has successfully completed its first test flight. It is presently noted that the several glitches encountered during the flight were autonomously responded to by the aircraft's control system in ways that deepen confidence in its ability to overcome routine difficulties.

AIAA

Reconnaissance Aircraft; Drone Aircraft; Flight Tests

19980051222

Aerospace technology. I - Software, electronics, and materials propel airliner design

Gottschalk, Mark A., USA; Design News; Sep. 08, 1997; ISSN 0011-9407; In English; Copyright; Avail: Aeroplus Dispatch

An overview of Boeing's focus on issues of aircraft safety, maintainability, product life, decrease of the development cycle, and lowering of costs for both acquisition and operation is presented. Consideration is given to the focus on the man/machine interface; knowledge-based engineering; evolution of the 'virtual' airplane; improved flight-safety systems; quieter, more community-friendly aircraft; and application of advanced materials.

AIAA

Aircraft Design; Commercial Aircraft; Passenger Aircraft; Boeing Aircraft; Technology Assessment; Aircraft Construction Materials; Computer Aided Design

19980051365

Development of probabilistic design methodology for composite structures

Gary, P. M., Vought Aircraft Co., USA; Riskalla, M. G., Vought Aircraft Co., USA; 1997; In English

Contract(s)/Grant(s): N00019-18-D-0248

Report No.(s): DOT/FAA/AR-95/17; Copyright; Avail: Aeroplus Dispatch

This program was conducted to perform technical studies to aid in the development of a probabilistic design methodology. The foundation of the probabilistic design approach, applied to composite structure, is to base design criteria and objectives on reliability targets instead of factors of safety. Control of the process, in terms of how much it differs from the traditional approach, is maintained by the probability of structural failure. The key technical issues addressed in this contract were the overall assessment of the accuracy of the methodology, current reliability experience, definition of appropriate goals, and database development. The overall assessment of the accuracy of the methodology was done by reviewing current published documents and papers in the probabilistic design field. This review focused on similarities and differences between the approaches. The database development was done by visiting airline maintenance depots and naval aviation depots to collect data on structural failures. The analyses of such data produced historical values for aircraft structural reliability. Current structural reliability issues and reliability goals were addressed by analyzing the wing box of the Lear Fan aircraft using a probabilistic design model. Measures of structural reliability such as single flight hour probability of failure for the whole wing box, including upper skin, lower skin, and substructure were produced.

Author (AIAA)

Structural Design; Composite Structures; Probability Theory; Failure Analysis; Lear Jet Aircraft; Structural Reliability; Aircraft Structures

19980051557

Response and loads analysis of helicopter rotor blades with swept tips

Yang, Weidong, Nanjing Univ. of Aeronautics and Astronautics, China; Zhang, Chenglin, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Shicun, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 52-58; In Chinese; Copyright; Avail: Aeroplus Dispatch

A refined aeroelastic model of a helicopter rotor blade with swept tips is established based on model matching. Rotor structure parameters such as precone, pretwist, tip sweep, and drop angles are considered in the structure model. The nonuniform inflow induced by rotor wake is included in the aerodynamic model. For rotor wake analysis, the CVC wake model is used. The nonlinear aeroelastic responses of the rotor blade are solved by the finite element method in time. The effects of tip sweep angle on the aeroelastic response and hub loads of the helicopter rotor are investigated in forward flight. Numerical results show that the blade

response is sensitive to tip sweep angle. Tip sweep increases the blade torsional loads, and the rotor wake analysis is important for capturing the harmonics of vertical hub loads, flap bending moments, and low speed aerodynamic loads.
Author (AIAA)
Rotary Wings; Aeroelasticity

19980051598
X-36 testing gives Boeing jump on UCAV work
Scott, William B., USA; Aviation Week & Space Technology; Mar. 02, 1998; ISSN 0005-2175; Volume 14, no. 9, pp. 58-60; In English; Copyright; Avail: Aeroplus Dispatch

The experience gained by Boeing during its 31-flight test program with the X-36 unmanned combat air vehicle (UCAV) establishes a basis for participation in a DARPA/USAF study of UCAVs that will assess potential missions and the costs of developing and fielding a UCAV fleet. At issue will be the relative affordability and comparative performance of UCAVs vs manned aircraft.
AIAA
X-36 Aircraft; Boeing Aircraft; Aircraft Design; NASA Programs; Pilotless Aircraft

19980051695
Unique structural problems in supersonic aircraft design
Mitchell, F. P., Avro Aircraft, Canada; Structures technology - Historical perspective and evolution; 1998, pp. 383-391; In English; Copyright; Avail: Aeroplus Dispatch

Some major problems associated with the structural design of supersonic aircraft are examined in broad terms. In particular, attention is given to problems associated with load analysis, fatigue, internal pressures, landing gear, and heat. Consideration is also given to strength properties, transient temperatures, creep, and advances in materials technology.
AIAA
Supersonic Aircraft; Aircraft Design; Wing Profiles; Fatigue Life; Internal Pressure; Landing Gear

19980051700
Structures for hypervelocity flight
Shih, Peter K., General Dynamics Corp., USA; Zwan, Allen D., General Dynamics Corp., USA; Kelley, Michael N., General Dynamics Corp., USA; Prunty, Jack, General Dynamics Corp., USA; Structures technology - Historical perspective and evolution; 1998, pp. 355-358; In English; Copyright; Avail: Aeroplus Dispatch

Thermo-structural design concepts for a cryogenically fueled rocket-powered transatmospheric vehicle are examined with particular reference to the results of a study sponsored by the Air Force Wright Aeronautical Labs. The vehicle has a high hypersonic lift-to-drag ratio for maximum glide range. Study results showed that peak temperatures on windward surfaces vary between 2600 and 3000 F. After thermo-structural optimization techniques yielded a promising concept, application of advanced technology began. Materials considered include commercially available materials, such as silicon carbide/aluminum, silicon carbide/titanium, and silicon carbide/superalloy metal matrix composites; rapidly solidified alloys; intermetallic compounds; advanced organic matrix composites; and improved carbon-carbon coating systems.
AIAA
Hypervelocity Flow; Aerodynamic Heating; Aircraft Design; Structural Design

19980051704
Design of airframes for nuclear power
Johnson, Clarence L., Lockheed Aircraft Corp., USA; Cleveland, F. A., Lockheed Aircraft Corp., USA; Structures technology - Historical perspective and evolution; 1998, pp. 321-339; In English; Copyright; Avail: Aeroplus Dispatch

The technical features and problems associated with nuclear-powered aircraft are examined from the standpoint of the airframe designer. The basic characteristics of the powerplant that dictate their recognition in the airframe design are identified as a highly concentrated weight in the reactor, a powerful radiation field emanating from the reactor, and no consequential flight endurance limitations by the powerplant fuel. The implications of these factors for airframe design are discussed, with attention given to such problems as crew personnel radiation exposure, maintenance personnel radiation exposure, airframe materials damage, and airborne equipment integrity of operation.
AIAA
Airframes; Nuclear Propelled Aircraft

19980051716

Noise, vibration, and aircraft structures

Regier, Arthur A., NACA, Langley Aeronautical Lab., USA; Structures technology - Historical perspective and evolution; 1998, pp. 177-186; In English; Copyright; Avail: Aeroplus Dispatch

Input-output relations for aircraft structures are examined for three general classes: discrete frequency (e.g., propellers), random frequency (e.g, jets), and impulsive (e.g., gun blasts or starting of rockets). It is noted that a study of input-output relations provides valuable guidance for solving specific noise and vibration problems. For simple panels, some success in stress prediction for random noise fields has been achieved. The need for more knowledge of the magnitude, phases, and various correlations of inputs of near-field noise, particularly for random sources, is emphasized.

AIAA

Aircraft Structures; Aircraft Noise; Structural Vibration

19980051727

Tomorrow's structural engineering

Warren, D. S., Douglas Aircraft Co., USA; Structures technology - Historical perspective and evolution; 1998, pp. 107-120; In English; Copyright; Avail: Aeroplus Dispatch

This article from a July 1973 issue of Astronautics and Aeronautics reviews the future of aircraft structural design with emphasis on advances in the areas of fatigue criteria, damage tolerant design, composites, computer-aided design, and manufacturing cost reduction. Some of the anticipated advances in structural technology discussed include the increasing use of computerized procedures for predicting static and dynamic loads, stresses, deflections, and flutter; advances in matrix structural technology; and further developments in aeroelasticity methods, integrated design/analysis systems, and direct structural synthesis. Other developments relate to the cost-effective use of advanced composites and active controls.

AIAA

Aircraft Structures; Structural Design; Computer Aided Design; Supersonic Aircraft; Transport Aircraft; Aeroelasticity

19980051728

The NASA structures and materials research program for supersonic-cruise aircraft

Cooper, Paul A., NASA Langley Research Center, USA; Heldenfels, Richard R., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 69-90; In English; Copyright; Avail: Aeroplus Dispatch

The research elements of the structures and materials part of the NASA Supersonic-Cruise Aircraft Research (SCAR) program, started in 1973, are reviewed. The SCAR structures and materials program emphasized technology and was concerned with advanced structural concepts, structural design procedures, aeroelastic loads and response, and materials applications. Because of limited resources, only research areas with long-term potential for high payoff were pursued. This paper discusses concept studies, advanced design codes, design synthesis procedures, flutter technology, transonic loads, landing loads, acoustic loads, atmospheric turbulence, new materials, environmental effects, and manufacturing technology.

AIAA

Supersonic Aircraft; Cruising Flight; NASA Programs; Aircraft Configurations; Aircraft Control; Wing Profiles

19980052521

Development of optimum structure for large aircraft

Hitchcock, L. M., Boeing Airplane Co., USA; Structures technology - Historical perspective and evolution; 1998, pp. 315-320; In English; Copyright; Avail: Aeroplus Dispatch

The 100-percent design approach, whereby the structure is designed to support full design loads, is examined as an optimal approach to the structural design of large aircraft. The philosophy of 100-percent design is considered beneficial in the development of large aircraft because it results in lightweight structure, assures that the static-test program is completed in a reasonable time period, provides maximum continuity for the production program, and permits early flight tests without excessive load factor restrictions. These advantages of 100-percent design are discussed and illustrated by specific examples.

AIAA

Aircraft Structures; Structural Weight

19980052525

DAMVIBS looks at rotorcraft vibration

Kvaternik, Raymond G., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 187-190; In English; Copyright; Avail: Aeroplus Dispatch

The DAMVIBS (design analysis methods for vibrations) was initiated in 1984 with the objective of establishing the technology base required for the development of an advanced finite element-based dynamics design analysis capability for helicopter vibrations. Under this program, industry teams developed finite element models, conducted ground vibration tests, and made extensive test/analysis comparisons of metal and composite airframes. The results of these efforts are briefly reviewed.
AIAA
Dynamic Structural Analysis

19980052529
The next careful steps in commercial aircraft structures
Sandoz, Paul L., Boeing Co., USA; Structures technology - Historical perspective and evolution; 1998, pp. 91-106; In English; Copyright; Avail: Aeroplus Dispatch

Research and development work carried out at the Boeing Company in the area of structural design and materials is briefly reviewed. The principal goals include fatigue design for 20 years of service and maximum reliability. The discussion covers studies in fatigue crack initiation in jet-transport structures, factors affecting structural reliability, fail-safe design, adhesively bonded structures, the use of advanced composites, and titanium sandwich structures.
AIAA
Commercial Aircraft; Aircraft Structures; Transport Aircraft

19980053588 RAND Corp., Santa Monica, CA USA
The Next-Generation Attack Fighter; Affordability and Mission Needs
Stevens, Donald, RAND Corp., USA; Davis, Bruce, RAND Corp., USA; Stanley, William, RAND Corp., USA; Norton, Daniel, RAND Corp., USA; Starr, Rae, RAND Corp., USA; Jan. 1997; 66p; In English
Report No.(s): AD-A331366; RAND-MR-719-AF; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report examines key affordability and mission needs issues for the Joint Strike Fighter (SF). This fighter is the subject of the ongoing Department of Defense Joint Advanced Strike Technology (JAST) program. Complementing the F-22, it could become the most numerous fighter in the Air Force inventory. The analysis here is tailored to support the Air Force in developing the JAST Mission Needs Statement (MNS) and the Operational Requirements Document (ORD), and in evaluating contractor studies. This work was done in the Aero-Systems Modernization Project, part of the Force Modernization and Employment Program of RAND’s Project AIR FORCE. It was sponsored by the DCS/Plans and Operations, Headquarters, USAF, and DCS/Requirements, Headquarters, Air Combat Command, The work should be of interest to personnel who address fighter requirements, force structure, and acquisition issues. Project AIR FORCE. a division of RAND, is the Air Force federally funded research and development center (FFRDC) for studies and analyses. It provides the Air Force with independent analysis of policy alternatives affecting the development, employment, combat readiness, and support of current and future aerospace forces. Research is being performed in three programs: Strategy and Doctrine, Force Modernization and Employment, and Resource Management and System Acquisition.
DTIC
Fighter Aircraft; Combat; Military Technology; Cost Estimates; Jet Aircraft

19980053593 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Report to Congressional Committees. Navy Aviation: V-22 Cost and Capability to Meet Requirements Are Yet to Be Determined
Oct. 1997; 22p; In English
Report No.(s): AD-A330863; GAO/NSIAD-98-13; B-272631; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The V-22 Osprey program was approved in 1982. The V-22 was being developed to meet joint service opera tional requirements that would satisfy various combat missions, including medium lift assault for the Marine Corps, search and rescue for the Navy, and special operations for the Air Force. The program advanced into full scale development in 1986. In December 1989, the Department of Defense (DoD) directed the Navy to terminate all V-22 contracts because, according to DOD, the V-22 was not affordable when compared to helicopter alternatives. DOD notified Congress that in order to satisfy the joint service requirements, the aircraft would require substantial redesign and testing. Congress continued to fund the program and in August 1992, the Acting Secretary of the Navy testified that a V-22 that met the joint service operational requirements could not be built with the funds provided. In October 1992, the Navy terminated the V-22 full scale development contract and awarded a contract to begin

engineering, manufacturing, and development (EMD) of a V-22 variant. During the FSD phase, five prototype aircraft were built. We have been monitoring the V-22 program for the past several years.
DTIC
Congressional Reports; Vertical Takeoff Aircraft; V-22 Aircraft; Product Development; Navy; Defense Program; Costs

19980053957
Rotorcraft subfloor design for enhanced crashworthiness characteristics
Hajela, P., Rensselaer Polytechnic Inst., USA; Lee, E.; Applied Mechanics Reviews; Nov, 1997; ISSN 0003-6900; Volume 50, no. 11 pt 2, pp. S72-S80; In English; 1997 5th Pan-American Congress of Applied Mechanics, Jan. 2-4, 1997, San Juan, PR, USA; Copyright; Avail: Issuing Activity

The present paper describes an approach for the optimal sizing of rotorcraft subfloor structures to minimize structural damage and the incidence of severe injury to the occupants under crash loads. The crash analysis in the present work was modeled through the use of a discrete analysis code (KRASH), which uses lumped masses, linear and nonlinear beam elements, and nonlinear spring elements to model the primary and secondary structures. The optimal load-deflection characteristics of the subfloor components, and the placement of these components in the subfloor region were then obtained through the use of a genetic algorithm-based search procedure. Finally, an inverse design approach was used to recover the dimensions of typical energy absorbing structural components that would yield the load deflection behavior derived in the previous step. A neural network-based response surface was constructed to alleviate the stiff computational requirements of this numerical procedure.
Author (EI)
Applications Programs (Computers); Rotary Wing Aircraft; Fuselages; Helicopters; Crashworthiness; Structural Analysis; Beams (Supports)

19980055435
Two-dimensional aircraft high lift system design and optimization
Besnard, Eric, California State Univ., Long Beach, USA; Schmitz, Adeline, California State Univ., Long Beach; Boscher, Edwan, California State Univ., Long Beach; Garcia, Nicolas, California State Univ., Long Beach; Cebeci, Tuncer, California State Univ., Long Beach; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0123; Copyright; Avail: Aeroplus Dispatch

A two-dimensional aircraft high-lift system design and optimization method, which can be easily extended to three dimensions, is presented. The need for such a tool is assessed. The method uses a gradient based local optimizer. The aerodynamic performance is predicted using an Interactive Boundary Layer (IBL) approach. Methods to represent general multi-element airfoils by a set of design variables are described. The representation of airfoils by general shape functions as well as element positioning (deflection angle, gap, overlap) is considered. The accuracy of the IBL approach when Reynolds number, element gap, overlap and deflection are varied is investigated. The design/optimization approach is first validated for an inverse design by matching a pressure coefficient distribution. Next, the method is applied to multi-element airfoil lift to drag ratio and single airfoil maximum lift coefficient maximization. Results demonstrate the appropriateness of the approach for high lift system design and optimization.
Author (AIAA)
Aircraft Design; Two Dimensional Flow; Lift Drag Ratio

19980055483
Aircraft conceptual design by collaborative manual and automatic agents
Shahroudi, K. E., Woodward Governor Co., Netherlands; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0176; Copyright; Avail: Aeroplus Dispatch

This paper briefly describes the semi-automatic design optimization setup which was introduced in full detail in a previous paper by the author. A simple multidisciplinary aircraft conceptual design optimization problem is then specified based on Torenbeek (1992). Various modes of in-the-loop user control on the search progress and the search problem illustrate the potential benefits of allowing the user to interact with a numerical agent at various levels of automation.
Author (AIAA)
Aircraft Design; Multidisciplinary Design Optimization

19980055490
Hot air anti-icing system modelization in the ice prediction code CANICE
Morency, F., Ecole Polytechnique, Canada; Brahimi, M. T., Ecole Polytechnique, Canada; Tezok, F., Ecole Polytechnique, Ca-

nada; Paraschivoiu, I., Ecole Polytechnique, Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0192; Copyright; Avail: Aeroplus Dispatch

The aim of the present work is to improve ice simulation methods, first by developing a mathematical model to simulate a hot air anti-icing system using the ice prediction code CANICE, and then by analyzing the heat transfer phenomenon on airfoil. A simple mathematical model is proposed to simulate temperature changes in the runback water film and conduction in airfoil skin. Heat flux from hot air circulating inside the airfoil is estimated by way of an internal convection coefficient. It appears that runback water temperature prediction compares well to other numerical results available in the literature. Heat lost due to convection and evaporation are presented for constant temperature and constant heat flux cases. Results show that heat lost to evaporation increases faster with temperature than heat lost due to convection.
Author (AIAA)
Antifreezes; Mathematical Models; Aircraft Icing; Airfoils; Deicers; Heat Transfer

19980055491
3D thermal analysis of an anti-icing device using FENSAP-ICE
Croce, G. F., Concordia Univ., Canada; Habashi, Wagdi G., Concordia Univ., Canada; Guevremont, Grant, Pratt & Whitney Canada, Longueuil; Tezok, Fatih, Bombardier, Inc., Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0193; Copyright; Avail: Aeroplus Dispatch

A thermal anti-icing device is studied by means of a 2D/3D Navier-Stokes code developed at Concordia University. The accuracy of the prediction is checked with experimental data for a Canadair test model. Numerical results show the great complexity of the flow inside the slat of an aircraft wing, and the strong influence of design parameters, such as the inlet mass flow and momentum, on the flow structure. A parametric analysis of these design parameters was carried out over a 2D configuration, using appropriate spanwise averaging to ensure global balance correspondence with the 3D case. Three-dimensional computations and conjugate heat transfer computations show the capability of the Navier-Stokes approach to give a more meaningful picture of the real, complex 3D flow.
Author (AIAA)
Three Dimensional Models; Thermal Analysis; Deicing; Antifreezes; Navier-Stokes Equation; Aircraft Icing

19980055494
Three dimensional droplet trajectory code for propellers of arbitrary geometry
Farag, K. A., Illinois, Univ., Urbana, USA; Bragg, M. B., Illinois, Univ., Urbana; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0197; Copyright; Avail: Aeroplus Dispatch

A 3D droplet impingement code for aircraft propellers has been developed. The code allows the modeling of propellers of arbitrary geometry in 3D, but is limited to modeling axisymmetric spinner/nacelle combinations. The code was used to analyze several 3D wind tunnel propeller-nacelle models, which were experimentally studied. The code was also used to validate a theoretical relationship between 2D and 3D impingement efficiencies for rotating propellers. The effects of the spinner, engine nacelle geometry, contraction of the slipstream, and blade-to-blade interference on the impingement efficiency and limits of impingement were studied. Parametric studies of the effects of the advance ratio J and droplet size on the efficiencies and limits were performed.
Author (AIAA)
Drops (Liquids); Impingement; Propellers; Three Dimensional Models; Wind Tunnel Tests; Aircraft Icing

19980055495
Experimental validation of the hybrid airfoil design procedure for full-scale ice accretion simulation
Saeed, Farooq, Illinois, Univ., Urbana, USA; Selig, Michael S., Illinois, Univ., Urbana; Bragg, Michael B., Illinois, Univ., Urbana; Addy, Harold E., Jr., NASA Lewis Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NCC3-408
Report No.(s): AIAA Paper 98-0199; Copyright; Avail: Aeroplus Dispatch

This paper presents results from the first series of ice accretion tests performed to validate the hybrid airfoil design method of Saeed et al. (1995). The hybrid airfoil design method was developed to facilitate the design of hybrid or subscale airfoils with full-scale leading edges and redesigned aft sections that exhibit full-scale airfoil water droplet impingement characteristics throughout a given alpha-range. The formulation is based on the assumption that the leading-edge ice accretion will be the same between the full-scale and hybrid airfoils if droplet cloud properties, droplet impingement, local leading-edge flow field, model surface geometry, model surface quality, and model surface thermodynamic characteristics are the same. Thus, if ice accretion

simulation could be predicted in terms of the droplet impingement characteristics alone, a myriad of issues related to ice accretion scaling could be avoided for tests where leading-edge ice accretion is desired.
Author (AIAA)
Proving; Airfoil Profiles; Ice; Deposition; Drops (Liquids); Impingement

19980055496

3D droplets impingement analysis around an aircraft's nose and cockpit using FENSAP-ICE

Boutanios, Zaid, Concordia Univ., Canada; Bourgault, Yves, Concordia Univ., Canada; Habashi, Wagdi G., Concordia Univ., Canada; Issac, George A., Environment Canada, Downsview; Cober, Stewart G., Environment Canada, Downsview; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0200; Copyright; Avail: Aeroplus Dispatch
The In-Flight Icing Consortium is constructing a modern simulation code for icing. FENSAP-ICE, a 3D Navier-Stokes code, will be able to simulate impingement, accretion, performance degradation and de- and anti-icing. FENSAP-ICE is based on an Eulerian approach for droplet impingement. Code validation in 2D and 3D is presented against published NASA experimental impingement results, and a 3D simulation of a Canadian Freezing Drizzle Experiment (CFDE) flight segment with Supercooled Large Droplets (SLD) is presented as well. Actual droplets diameters distributions measured from the aircraft sensors are used as code input, and results are provided for several droplets diameters, distribution median volume diameter, and combined solutions of several diameters.
Author (AIAA)
Three Dimensional Models; Drops (Liquids); Impingement; Cockpits; Noses (Forebodies); Aircraft Icing

19980055507

Numerical simulations and potential applications of zero-mass jets for enhanced rotorcraft aerodynamic performance

Hassan, Ahmed A., Boeing Co., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0211; Copyright; Avail: Aeroplus Dispatch
An overview of recent progress in the numerical simulation of 'zero-mass' jets and their impact on the aerodynamics of lifting and nonlifting surfaces is presented. Examples are drawn from potential applications to specific rotorcraft, tiltrotor aircraft, high-speed compound aircraft aerodynamic problems which, in many facets, parallel those for fixed wing commercial and military aircraft. Specifically, the emulation of the aerodynamic effects that result from the use of conventional control surfaces and the alleviation of the impulsive aerodynamic response that results from the interaction between the tip vortex wake and the rotor blades (blade-vortex interactions, BVIs) is discussed. Simple logic is used to follow the progression in active flow control technology from the use of a blade-mounted trailing edge flap, the use of continuous blowing, and finally the use of zero-mass jets. It is shown that this progression is primarily driven by the need for lower BVI noise levels and by the need for improved aerodynamic performance for conventional helicopters, tiltrotor aircraft, and high-speed compound aircraft.
Author (AIAA)
Digital Simulation; Jet Control; Lifting Bodies

19980055668

Development of subsonic transports with natural laminar flow wings

Lee, Jae-Moon, Georgia Inst. of Technology, Atlanta, USA; Schrage, Daniel P., Georgia Inst. of Technology, Atlanta; Mavris, Dimitri N., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0406; Copyright; Avail: Aeroplus Dispatch
The two main sources of drag that can account for more than 80 percent of the total drag for current subsonic aircraft are friction and induced drag. A new Natural Laminar Flow (NLF) wing design methodology has been established to minimize these two important sources of drag. According to this method, a synthesis and sizing code, is used to estimate the benefits of NLF technology at the system level, and determine optimal wing planform geometry and wing area for a given mission requirement. Then, the chordwise pressure distribution and the spanwise lift distribution of the previously optimized NLF wing planform from the sizing code are parameterized carefully on the basis of physical insights. An inverse aerodynamic design technique is then used to find the corresponding airfoil geometry for a given pressure distribution. Finally, a metamodel building method, the 'Response Surface Methodology' is used to minimize the drag of the wing at the design cruise condition, given by the sizing code, with respect to the parameters related to the chordwise pressure distribution and the spanwise lift distribution of the NLF wing

simultaneously. In this procedure, the accurate prediction of the onset of laminar-to-turbulent transition is crucial to estimate the skin friction drag.
Author (AIAA)
Subsonic Aircraft; Transport Aircraft; Laminar Flow; Drag

19980055670
Nonlinear rate and amplitude effects on a generic combat aircraft model
Ericsson, Lars E., NRC of Canada Inst. for Aerospace Research, Canada; Beyers, Martin E., NRC of Canada Inst. for Aerospace Research, Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0409; Copyright; Avail: Aeroplus Dispatch

A study was made of the unusual results obtained in large-amplitude oscillatory-coning or pitching tests of a combat aircraft model. The conceptual analysis shows that the observed highly nonlinear effects of angular amplitude and rate on the unsteady aerodynamics can be explained by using the knowledge of unsteady separated flow physics gained from one-degree-of-freedom dynamic experiments.
Author (AIAA)
Fighter Aircraft; Aircraft Models; Pitching Moments; Unsteady Aerodynamics; Separated Flow; Forebodies

19980055695
2020 - Future vision for Global Air Cargo
Logan, Michael J., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0437; Copyright; Avail: Aeroplus Dispatch

This paper describes a study conducted as a part of the NASA Scenario-Based Strategic Planning process. During this process, Global Air Cargo was identified as one of several potential high-payoff vehicle classes for the year 2020. Within this vehicle class, a goal was established to provide a ten-fold reduction in the cost per ton-mile for air cargo shipments. In order to assess the issues associated with achieving this goal, a detailed systems analysis was conducted for this class of vehicle. The current air cargo industry was examined to determine potential design requirements including range (by virtue of airport-to-airport distance pairings), operating field length requirements (determined from a statistical analysis of current airport infrastructure), and specific design features (e.g., intermodal container carriage, joint civil/military use). The results indicate that a 75 percent reduction in the cost per ton-mile for cargo transportation (relative to DC-10-30F) is potentially achievable. In addition, a payload increase of 3x (over C-5B maximum) with a concurrent range improvement of 2.5x (relative to a C-5B) is also potentially achievable even within the current airport infrastructure limitations.
Author (AIAA)
Air Cargo; Technological Forecasting; NASA Programs; Cost Reduction; Passenger Aircraft; Aircraft Configurations

19980055696
Blended-wing-body subsonic commercial transport
Liebeck, R. H., Boeing Co., USA; Page, M. A., Boeing Co., USA; Rawdon, B. K., Boeing Co., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20275
Report No.(s): AIAA Paper 98-0438; Copyright; Avail: Aeroplus Dispatch

The blended-wing-body (BWB) airplane concept represents a potential revolution in subsonic transport efficiency for large airplanes. NASA has sponsored an advanced concept study to demonstrate feasibility and begin development of this new class of airplane. In this study, 800 passenger BWB and conventional configuration airplanes have been compared for a 7000 nautical mile design range, where both airplanes are based on technology for a 2020 entry into service. The BWB has been found to be superior to the conventional configuration in all key measures. The BWB advantage results from a double deck cabin that extends spanwise, providing structural and aerodynamic overlap with the wing. This reduces the total wetted area of the airplane and allows a long wingspan to be achieved, since the deep and stiff centerbody provides efficient structural wingspan. Further synergy is realized through buried engines that ingest the wing's boundary layer, and thus reduce effective ram drag. Relaxed static stability allows optimal span loading and obviates the need for a tail. An outboard leading-edge slat is the only high-lift system required.
Author (AIAA)
Subsonic Aircraft; Body-Wing Configurations; Commercial Aircraft; NASA Programs; Transport Aircraft; Aircraft Design

19980055697
Advanced configurations for very large transport airplanes
McMasters, John H., Boeing Co., USA; Kroo, Ilan M., Stanford Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0439; Copyright; Avail: Aeroplus Dispatch

This paper addresses the following questions: How large can an airplane of 707/747 configuration be built and still remain economically and operationally viable? What configuration alternatives might allow circumvention of practical size limitations inherent in the basic 707/747 configuration? What new and/or dormant technology elements might be brought together in synergistic ways to resolve or ameliorate very large subsonic airplane problems? to explore these and a number of related issues, a team of Boeing, university, and NASA engineers was formed under the auspices of the NASA Advanced Concepts Program during 1994. The results of a Research Analysis contract focused on a large, unconventional (C-wing) transport configuration for which Boeing and the authors were granted a design patent in 1995 is the subject of this paper, which is based on information contained in NASA CR 198351 released in October 1996.

Author (AIAA)

Aircraft Configurations; Transport Aircraft; Aircraft Design; NASA Programs; Cost Analysis

19980055698

An airplane configuration with an inboard-wing mounted between twin fuselages

Spearman, M. L., NASA Langley Research Center, USA; Feigh, Karen M., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0440; Copyright; Avail: Aeroplus Dispatch

This paper describes an airplane configuration that is different from a conventional wing-body-tail design. The required wing area is located in the center for this configuration, and the wing is bounded by twin tip-mounted fuselages. There are no outboard cantilevered wing panels as found on conventional airplane designs. The intent of this arrangement is to provide an increase in payload capacity without an increase in overall length and width when compared to current designs and to achieve 2D flow on the wing by eliminating free wing tips so that the wing tip flow that produces an induced drag and a hazardous trailing vortex would not exist.

Author (AIAA)

Aircraft Configurations; Fuselages; Body-Wing Configurations; Aircraft Design; Wing Panels; Vortices

19980055742

Effect of nose slenderness on forebody flow control

Ericsson, Lars E., Inst. for Aerospace Research, Canada; Beyers, Martin E., Inst. for Aerospace Research, Canada; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0499; Copyright; Avail: Aeroplus Dispatch

When attempting to transfer the forebody flow control technology developed on military aircraft to commercial aircraft, such as the Boeing 1804 SST, additional flow parameters become important. The reason for the complication of the technology transfer is the large difference in forebody slenderness, with apex half-angles below 10 deg in the commercial case compared to above 25 deg for military aircraft. Available experimental results are interpreted on the basis of the existing data base for bodies of revolution.

Author (AIAA)

Forebodies; Bodies of Revolution; Technology Transfer; Military Aircraft; Commercial Aircraft

19980055748

Flexible aircraft in conceptual design HALEs on the way to ornithopter

Pendaries, Celine, ONERA, Centre d'Etudes et de Recherches de Toulouse; SupAero, France; Boiffier, Jean-Luc, ONERA, Centre d'Etudes et de Recherches de Toulouse; SupAero, France; Jeanneau, Matthieu, ONERA, Centre d'Etudes et de Recherches de Toulouse; SupAero, France; Barrau, Jean-Jacques, Toulouse III, Univ., France; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0505; Copyright; Avail: Aeroplus Dispatch

In order to achieve their outstanding performances, high-altitude long endurance aircraft (HALEs) require a unique design with high aspect ratio wings and low wing loading. These characteristics imply flexibility, low frequency modes and aeroelastic phenomena at low speed. Wing flexibility has to be taken into account at an early stage of conceptual aircraft design. A structural embeded wing model is presented in this paper which is simplified and computationally efficient enough to involve flexibility in a large optimization process. The aerodynamics acting on this wing are also detailed. The Flutter Prediction Program (FPP) was evaluated both numerically with CATIA and experimentally by studying the aeroelastic behavior of a wing model in a wind-tunnel. The comparison is based on the flutter speed and the evolution of the modes with air speed. Another application of the FPP is also developped, namely propulsion by wing flapping through the first bending mode without articulation at the wing root.

We demonstrate that the flapping of a wing produces enough thrust to provide propulsion of a HALE ’gnopter’ with good efficiency.
Author (AIAA)
Aircraft Design; Wing Profiles; Aeroelasticity; Flutter

19980055762

Spatial characteristics of the unsteady differential pressures on 16 percent F/A-18 vertical tails

Moses, Robert W., NASA Langley Research Center, USA; Ashley, Holt, Stanford Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0519; Copyright; Avail: Aeroplus Dispatch

For the F/A-18 at high angles of attack, vortices emanating from wing/fuselage leading edge extensions burst, immersing the vertical tails in their turbulent wake. The resulting buffeting of the vertical tails is a concern from fatigue and inspection points of view. to learn more about the spatial characteristics of the unsteady differential pressures, an available 16 percent, sting-mounted, F-18 wind-tunnel model was modified and tested in the Transonic Dynamics Tunnel (TDT) at NASA-Langley as part of the Actively Controlled Response of Buffet-Affected Tails program. Surface pressures were measured at high angles of attack on flexible and rigid tails. Cross-correlation and cross-spectral analyses of the pressure time histories indicate that the unsteady differential pressures are not fully correlated. In fact, the unsteady differential pressures resemble a wave that travels along the tail. At constant angle of attack, the pressure correlation varies with flight speed.
Author (AIAA)
F-18 Aircraft; Tail Assemblies; Aeroelasticity; Angle of Attack; Buffeting; Vortices

19980055765

Measurement and simulation of wake deceleration

Hoffenberg, R., Purdue Univ., USA; Sullivan, J. P., Purdue Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG2-854
Report No.(s): AIAA Paper 98-0522; Copyright; Avail: Aeroplus Dispatch

Transport aircraft performance is strongly influenced by the effectiveness of the high-lift system. Wakes subjected to strong adverse pressure gradients in high-lift systems can thicken very rapidly, limiting maximum lift. A combined experimental and computational investigation has been conducted to evaluate performance of several turbulence models in simulating this type of flow. In the experiment, a turbulent wake was subjected to adverse pressure gradients in a symmetric diffuser. LDV surveys, pressure measurements, and flow visualization were used to investigate the physics of this decelerated wake, through the onset of wake reversal. Navier-Stokes calculations were also performed for a flat plate wake in a 2D diffuser. For diffuser angles similar to the experiment, the calculations under-predicted wake growth and failed to demonstrate wake reversal.
Author (AIAA)
Wakes; Deceleration; Transport Aircraft; Lift; Computational Fluid Dynamics; Laser Doppler Velocimeters

19980055768

Computational simulation of the F-22 aircraft

Josyula, Eswar, USAF, Research Lab., USA; Gordiner, Raymond E., USAF, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0526; Copyright; Avail: Aeroplus Dispatch

A numerical simulation is presented for the steady state flow over an F-22 aircraft configuration for subsonic Mach numbers at different angles of incidence and sideslip angle. Flow conditions are Mach 0.4 at 10, 20, and 30 deg angle-of-attack and Mach 0.6 at 24 deg angle-of-attack with sideslip angles of 0 and 6 deg. The Reynolds number based on the length of the wingroot chord of the model is 4.6 million to simulate the wind tunnel conditions. The 3D Navier-Stokes equations in mass-averaged form are numerically integrated using the implicit Beam and Warming algorithm with the two-equation k-epsilon turbulence model to provide closure of the system of equations. The Chimera overset grid method is used, with the Pegasus code providing the inter-grid communication. Code validation is accomplished by comparing the computed surface pressure coefficients with the experimental measurements. The predictions are in good agreement for the lower angles-of-attack, and the trends are in accordance with the experimental observations. Effects of angle-of-attack and sideslip angle are qualitatively studied on the external flow field of the full aircraft. Important flow features are identified and discussed. Vortex trajectories and strengths are shown for all cases to afford a relative comparison of the flow physics.
Author (AIAA)
Computerized Simulation; F-22 Aircraft; Steady Flow; Subsonic Flow; Incidence; Sideslip

19980055830

Optimization of a realistic flap design for in-flight transonic performance enhancement

Siclari, M. J., Northrop Grumman Corp., USA; Austin, F., Northrop Grumman Corp., USA; Jan. 1998; In English
Contract(s)/Grant(s): F33615-95-C-3202; NAG1-1559
Report No.(s): AIAA Paper 98-0596; Copyright; Avail: Aeroplus Dispatch

A Smart Trailing Edge design concept consisting of a segmented flap trailing edge system is studied to determine the potential payoffs for reducing drag at off-design flight conditions. The flap system being developed will employ smooth hinge lines and a new type of electromagnetically driven smart material linear actuator completely embedded in the wing structure. Realistic flap geometries are numerically simulated which include the effects of both rotation and translation in the design along with a smooth upper surface and lower surface linear tabs to close the gaps. A multiobjective, stochastic, numerical optimization scheme is used to study the various parametric tradeoffs including the number of flap segments using a full potential flow solver coupled to an integral boundary layer method. The results of the optimization are checked for validity and flow separation using a Navier-Stokes solver. For all flight conditions, the flap system is shown to reduce drag, indicating promise for the concept.
Author (AIAA)

Transonic Flight; Trailing Edge Flaps; Airfoil Profiles; Navier-Stokes Equation; Drag Reduction

19980055831

Weissinger's model of the nonlinear lifting-line method for aircraft design

Owens, D. B., NASA Langley Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NASW-4907
Report No.(s): AIAA Paper 98-0597; Copyright; Avail: Aeroplus Dispatch

A method is presented that allows for the calculation of nonlinear aerodynamics within the time constraints of the conceptual design phase. This method was developed with characteristics of a design-oriented analysis technique: adequate accuracy, computational efficiency, accuracy and speed tradeoff and minimal time for geometric input and modification. In addition, the code can be readily coupled to other analysis codes, e.g. with a structural analysis code, which is important for the use in multidisciplinary design optimization. The method is based on Weissinger's (1947) lifting-line model. In addition, it incorporates the Biot-Savart law, Kutta-Joukowski theorem, and airfoil lift data. Results of swept and unswept wings show very favorable agreement with experiment.
Author (AIAA)

Aircraft Design; Nonlinear Systems; Kutta-Joukowski Condition; Lift

19980055832

Manual aerodynamic optimization of an oblique flying wing

Li, P., Colorado, Univ., Boulder, USA; Seebass, Richard, Colorado, Univ., Boulder; Sobieczky, H., DLR, Germany; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0598; Copyright; Avail: Aeroplus Dispatch

We use a manual method and an advanced geometry generator to optimize a large wing flying obliquely at Mach 2, designing the airfoil sections, choosing a wing planform, and blending the airfoils of these sections to create a wing. A manual tailoring of the wing planform and bending are used to provide a nearly elliptic load. The lift coefficient and sweep are varied sequentially to arrive at an optimum inviscid design. Considering this wing to be a flat plate, the viscous drag is computed. The altitude at which the wing enters cruise is selected to maximize L/D. This results in an Oblique Flying Wing with a viscous ML/D of 23.5, which compares well with the linear theory optimum of 25.2.
Author (AIAA)

Oblique Wings; Tailless Aircraft; Aerodynamic Configurations; Wing Planforms; Transport Aircraft

19980055833

Aerodynamic design of transonic wing using the target pressure optimization approach

Kim, Hyoung-Jin, Seoul National Univ., Republic of Korea; Rho, Oh-Hyun, Seoul National Univ., Republic of Korea; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0599; Copyright; Avail: Aeroplus Dispatch

A design study of transonic wings has been performed by the hybrid inverse optimization method. An existing target pressure optimization code for the transonic airfoil inverse design has been extended to obtain a target pressure distribution for transonic wing design. The shock strength was minimized and the isobar line sweep angle on the upper surface of the wing was maximized to obtain minimum compressibility drag. With the target pressure at each design section, an inverse design code was run to obtain

a subsequent wing geometry. The designed wing showed better performance than the baseline wing at the given design condition, and geometric constraints on the section contour area were successfully satisfied. Design results showed that the inverse design using the target pressure optimization approach is very efficient in obtaining a transonic wing of high performance at a given design condition. However, single-point designs do not guarantee off-design performance. Multipoint design is needed to obtain a transonic wing of high performance at broader range of flow conditions.
Author (AIAA)
Aerodynamic Configurations; Transonic Speed; Optimization; Wings; Computational Fluid Dynamics; Pressure Distribution

19980055835

Inverse optimization of transonic wing shape for mid-size regional aircraft

Takahashi, Shinichi, Tohoku Univ., Japan; Obayashi, Shigeru, Tohoku Univ., Japan; Nakahashi, Kazuhiro, Tohoku Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0601; Copyright; Avail: Aeroplus Dispatch

Multiobjective genetic algorithms (MOGAs) have been applied to design a transonic wing shape. First, the wing planform is optimized by solving a multidisciplinary optimization problem based on aerodynamic, structural and fuel-storing objectives and constraints. Second, 3D target pressure distribution is optimized for the aerodynamic inverse design with the previously designed planform. Minimization of the profile drag and the induced drag is performed under constraints on lift and other design principles. Corresponding wing surface geometry is obtained by Takanashi's (1985) method. These two multiobjective optimization problems are solved by Pareto-based MOGAs coupled with appropriate CFD solvers. Applying these two wing design procedures, Pareto surfaces can be studied for trade-offs and a good compromise solution for the wing design can be obtained.
Author (AIAA)
Wing Planforms; Genetic Algorithms; Pressure Distribution

19980055836

Inverse design method for wings of supersonic transport

Jeong, Shinkyu, Tohoku Univ., Japan; Matsushima, Kisa, Fujitsu, Ltd., Japan; Iwamiya, Toshiyuki, National Aerospace Lab., Japan; Obayashi, Shigeru, Tohoku Univ., Japan; Nakahashi, Kazuhiro, Tohoku Univ., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0602; Copyright; Avail: Aeroplus Dispatch

A practical inverse design method for supersonic airfoils/wings has been developed. The method is based on Takanashi's (1985) iterative 'residual-correction' concept. A geometry that materializes a specified pressure distribution is sought by solving an integrodifferential form of the linearized small perturbation equation. The integration is limited to the Mach forecone from the point of interest. Several design results are presented.
Author (AIAA)
Supersonic Transports; Wing Planforms; Iterative Solution; Design Analysis

19980055966

A design methodology for semi-span model mounting geometries

Milholen, William E., II, NASA Langley Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NASW-4907
Report No.(s): AIAA Paper 98-0758; Copyright; Avail: Aeroplus Dispatch

A computational study was conducted to examine the influence of the semi-span model standoff nose shape on the separation of the sidewall boundary layer. A parametric family of standoff nose shapes was developed which includes both filleted and undercut geometries. A three-dimensional Navier-Stokes solver was used to examine the performance of the new standoff nose shapes. The semi-span configurations examined included a cruise wing commercial transport, and a simplified transport configuration. The semi-span computational results were compared to computational results for the corresponding full-span model to assess the performance of the new standoff nose shapes. Several filleted and undercut nose shapes were found to eliminate the separation of the sidewall boundary layer which occurs with the original nose shape. The sidewall streamline patterns were dramatically improved, and found to be quite similar to the symmetry plane streamline patterns of the full-span configuration. The new standoff nose shapes were also found to improve the agreement between the semi-span and full-span fuselage centerline pressure distributions. For the simplified semi-span configuration, the computational results were found to be in excellent agreement with the experimental results.
Author (AIAA)
Aircraft Design; Semispan Models; Boundary Layer Separation; Aircraft Models; Fuselages; Noses (Forebodies)

19980055968

Stall resistance features of lifting-body airplane configurations

Katz, Joseph, San Diego State Univ., USA; Byrne, Shaun, San Diego State Univ., USA; Hahl, Robert, Redwood Aircraft Corp., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0760; Copyright; Avail: Aeroplus Dispatch

A generic lifting-body airplane model was tested in a low-speed wind tunnel. The experimental data indicate that at lower angles of attack the lift-over-drag ratio is comparable to other high-efficiency designs. The high angle of attack aerodynamics of this configuration is influenced by the side-edge vortex system observed above the aft section of the lifting fuselage. Consequently, the total lift of the airplane model continues to increase beyond the angle of wing stall, accompanied by increasing nose-down pitching moments. In principle, such characteristics allow the tailoring of the configuration lift and pitching moment in a manner that lift-loss effects beyond wing stall are minimal. Furthermore, the sharp increase in the nosedown moment of the fuselage can be positioned within the angle-of-attack performance curve such that airplane stall can become unreachable (and the configuration becomes stall resistant). The present study investigates some of the geometrical parameters influencing these aerodynamic effects so that such inherent stall-resistant characteristics can be developed early in the design stage of a lifting-body airplane configuration.

Author (AIAA)

Aircraft Configurations; Lifting Bodies; Aerodynamic Stalling; Aircraft Models; Low Speed Wind Tunnels

19980055969

Low-aspect-ratio wings for wing-ships

Filippone, Antonino, Illinois, Univ., Urbana, USA; Selig, Michael S., Illinois, Univ., Urbana; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0761; Copyright; Avail: Aeroplus Dispatch

Flying in ground poses technical and aerodynamical challenges. The requirements for compactness, efficiency, maneuverability, off-design operation, open new areas of investigations in the field of aerodynamic analysis and design. A review of the characteristics of low-aspect ratio wings, in and out-of-ground, is presented. It is shown that the performance of such wings is generally inferior to that of slender wings, although in ground placement can yield substantial improvements in the aerodynamic efficiency. The use of tip devices, such as winglets and endplates, or an appropirate tip design, can change substantially the characteristics of the wing. Thin and thick airfoil sections are designed in ground effect, by using a multipoint inverse design method based on conformal mapping, to perform best either at constant lift or at increasing ground clearance. Three-dimensional computations have been performed with a panel code (VSAER0), and compared with available experimental data at aspect-ratios as low as 1. Wings of aspect-ratio 1.5 to 2.5 having the airfoil sections presented in this work have been computed at various ground clearances. It is concluded that design in ground effect is possible, and that the existing computational methods are adequate for an approximate study of low-aspect-ratio wings, although many flow phenomena require detailed investigastions.

Author (AIAA)

Low Aspect Ratio Wings; Aerodynamic Characteristics; Ground Effect (Aerodynamics); Aircraft Design; Panel Method (Fluid Dynamics); Airfoil Profiles

19980055970

Effect of apex flap deflection on vertical tail buffeting

Massey, Steven J., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG1-648

Report No.(s): AIAA Paper 98-0762; Copyright; Avail: Aeroplus Dispatch

A computational study of the effect of vortex breakdown location on vertical tail buffeting is conducted. The position of the breakdown is modified by employing an apex flap deflected by an experimentally determined optimal angle. The delayed breakdown flow and buffering response is then compared to the nominal undeflected case. This multidisciplinary problem is solved sequentially for the fluid flow, the elastic tail deformations and the grid displacements. The fluid flow is simulated by time accurately solving the unsteady, compressible, Reynolds-averaged Navier-Stokes equations using an implicit, upwind, flux-difference splitting finite volume scheme. The elastic vibrations of the tails are modeled by uncoupled bending and torsion beam equations. These equations are solved accurately in time using the Galerkin method and a five-stage Runge-Kutta-Verner scheme. The grid for the fluid dynamics calculations is continuously deformed using interpolation functions to disperse the displacements smoothly throughout the computational domain. An angle-of-attack of 35 deg is chosen such that the wing primary-vortex cores experience vortex breakdown and the resulting turbulent wake flow impinges on the vertical tails. The dimensions and material properties of the vertical tails are chosen such that the deflections are large enough to insure interaction with the flow, and the natural frequencies are high enough to facilitate a practical computational solution. Results are presented for a baseline uncontrolled buffering

case and a delayed breakdown case in which the apex flap has been deflected 15 deg. The flap was found to be very effective in delaying the breakdown, increasing the location from 50 percent to 94 percent wing root chord, which resulted in a six percent increase in lift coefficient and pitching moment. However, the integrated buffet loads and tip responses were roughly equivalent for the two cases.
Author (AIAA)
Vortex Breakdown; Buffeting; Tail Assemblies; Stabilizers (Fluid Dynamics); Flux Difference Splitting; Wing Flaps

19980055974

Validation of an automated chimera methodology for aircraft escape systems analysis

Rock, S. G., CFD Research Corp., USA; Habchi, S. D., CFD Research Corp., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0767; Copyright; Avail: Aeroplus Dispatch

The objective of this work was to validate a recently developed automated-chimera, domain-decomposition algorithm for the aerodynamic analysis of aircraft escape systems. This automated-chimera methodology was incorporated into the CFD-FASTRAN flow solver, which also includes a six-degree-of-freedom (6DOF) model. In particular, the methodology was demonstrated and validated by reproducing: (1) a half-scale wind tunnel test of an ACES-II ejection seat separating from an F-16 forebody and (2) a full-scale sled test of an F/A-18 jettisonable canopy. Comparisons of CFD predictions and test data were made for six-component balance data, surface pressure data, and trajectory data.
Author (AIAA)
F-16 Aircraft; Escape Systems; Full Scale Tests; Aerodynamic Characteristics; Wind Tunnel Tests

19980055976

Numerical analysis of advanced fighter auxiliary power unit (APU) exhaust impingement

Cali, Philip M., USAF, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0770; Copyright; Avail: Aeroplus Dispatch

A three-dimensional, viscous, Computational Fluid Dynamics (CFD) analysis of the exhaust flow associated with the auxiliary power unit (APU) of an advanced fighter aircraft was conducted. Calculations were performed to investigate the level of surface heating on the fuselage adjacent to the APU exhaust port. The CFD model was constructed using the Chimera domain decomposition technique. A wingless (unclassified) fighter configuration consisting of five grids was used to provide the background flowfield for the APU investigation. Comparisons with wind tunnel test data were conducted to validate the fighter model before the APU geometry was added to the calculation. Seventeen additional Chimera grids were necessary to adequately model the APU. Two different APU configurations were analyzed to assess the effect of the position of a small surge line (used to discharge a supersonic flow bled from the APU inlet) on the APU exhaust flow. Results predicted that by relocating the APU surge line from its original position directly downstream of the APU exhaust port to a position directly inboard of the APU exhaust port, a significant reduction in the overall heat transfer to the fuselage could be achieved.
Author (AIAA)
Fighter Aircraft; Auxiliary Power Sources; Exhaust Gases; Viscous Flow; Aerodynamic Heat Transfer; Aircraft Engines

19980056038

Performance prediction and control system design of an aircraft skin cooling technique

Hashemi, Ab, Lockheed Martin Advanced Technology Center, USA; Fast, Mary, Lockheed Martin Advanced Technology Center, USA; Schneider, Julie, Lockheed Martin Advanced Technology Center, USA; Dyson, Elizabeth, Lockheed Martin Canada, Kanata; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0837; Copyright; Avail: Aeroplus Dispatch

This paper describes the steady state and transient thermal response of the aft cabin of an aircraft that is retrofitted with high-power electronic equipment and cooled by heat rejection through the skin. In this skin-cooling design, the outer surface of the fuselage is treated as a heat exchanger. Hot air from an equipment exhaust plenum is drawn into a series of baffled ducts within the fuselage support structure, where the heat is rejected, and then recirculated into the cabin. The cooler air from the cabin is then drawn into the electronic equipment. The aircraft air conditioning unit is also modeled to provide chilled air directly into the cabin. In addition, this paper presents an algorithm and a control system concept to maintain the temperature of the aft cabin within acceptable limits. Results establish a control system design, which is being implemented in a CL-600 Challenger aircraft.
Author (AIAA)
Aircraft Control; Skin (Structural Member); Control Systems Design; Transient Heating; Aircraft Compartments; Electronic Equipment

19980056039

Skin thermal response for an aircraft with supplementary skin cooling system

Hashemi, Ab, Lockheed Martin Advanced Technology Center, USA; Wong, Hubert, Lockheed Martin Advanced Technology Center, USA; Schneider, Julie, Lockheed Martin Advanced Technology Center, USA; Dyson, Elizabeth, Lockheed Martin Canada, Kanata; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0838; Copyright; Avail: Aeroplus Dispatch

A skin cooling design is being implemented for heat rejection from an aircraft containing high-power electronic equipment. In this concept, baffled ducts at the aircraft skin are used to cool the air in the aft cabin, where the equipment is located. The heat transfer through the skin causes the temperature of the skin to rise. to stay well within the airworthiness requirements of the aircraft, it is desired to maintain the skin and frame temperature below 50 C for all operational scenarios. This paper provides an estimate of the skin and frame temperatures for full operation scenarios. Results show that the potential hot spots remain well below 50 C for all flight conditions within the mission envelope.

Author (AIAA)

Aircraft Design; Skin (Structural Member); Cooling Systems; Electronic Equipment; Aircraft Compartments; Skin Temperature (Non-Biological)

19980056040

Aircraft skin-cooling air flow distribution

Schneider, Julie, Lockheed Martin Advanced Technology Center, USA; Spradley, Iran, Lockheed Martin Advanced Technology Center, USA; Hashemi, Ab, Lockheed Martin Advanced Technology Center, USA; Dyson, Elizabeth, Lockheed Martin Canada, Kanata; Nigen, Jay, Innovative Research, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0839; Copyright; Avail: Aeroplus Dispatch

This paper describes a series of tests that were performed to evaluate the feasibility of providing a common inhale/exhale opening in the ceiling plenum. This opening is to prevent the ceiling fans from starving when the equipment is off (inhale), and to avoid excessive pressurization of the system when the ceiling fans are off (exhale). The tests were performed using a representative plenum configuration. This paper also describes a simulation model of the plenum flow distribution system and comparison of the predicted result with the experimental measurements. Results show that a common inhale/exhale opening in the ceiling plenum is feasible for the aircraft supplementary cooling system. A substantially larger opening area in the plenum is required for the exhale mode of operation than is needed for the inhale scenario. Flow deflectors near the openings are required to prevent bi-directional flow through the openings during balanced flow mode of operation. The results also include the description of tested measurement techniques and selection of devices to optimize the size of the inhale/exhale opening.

Author (AIAA)

Aircraft Compartments; Skin Temperature (Non-Biological); Cooling Systems; Air Flow; Flow Distribution; Electronic Equipment

19980056096

A decoupled stochastic approach to the jig-shape aeroelastic wing design problem

Aly, Sherif, United Technologies Corp., Hamilton Standard Div., USA; Ogot, Madara, Rutgers Univ., USA; Pelz, Richard B., Rutgers Univ., USA; Siclari, Michael, Northrop Grumman Corp., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0906; Copyright; Avail: Aeroplus Dispatch

A novel approach to the jig-shape aeroelastic wing design problem is presented. Unlike previous design efforts, where the aerodynamic analyses were coupled to the structural analyses throughout the optimization process, this work presents a truly decoupled approach. The developed two-level methodology performs aerodynamic shape optimization at Level I to determine an optimal configuration, followed by structural shape optimization at Level II to find the corresponding jig-shape. During Level II optimization, no aerodynamic analyses are required, resulting in hue decoupling. This results in a significant reduction in computation time, making the design of relatively complex wing structures feasible. For this study, high-fidelity codes (ANSYS for the structural analysis and a supersonic Euler code) are used to provide accurate, detailed analyses. A modified simulated annealing algorithm is used as the optimizer. Two examples are presented, a forebody problem and the design of a High Speed Civil Transport wing, to demonstrate the efficacy of the methodology.

Author (AIAA)

Stochastic Processes; Aeroelasticity; Wings; Aircraft Design; Jigs

19980056097

Aeroelastic analysis of wing and wing/fuselage configurations

Chen, H. H., Boeing Co., USA; Chang, K. C., Boeing Co., USA; Tzong, T., Boeing Co., USA; Cebeci, T., Boeing Co., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0907; Copyright; Avail: Aeroplus Dispatch

An interface method developed to couple aerodynamics and structures is used to evaluate the aeroelastic effects of an advanced transport wing at cruise conditions. The calculated results are compared with wind tunnel test data. The capability of the interface method is also extended to wing/fuselage configurations. In addition, an aircraft trim analysis is described and applied to wing configurations.

Author (AIAA)

Aeroelasticity; Body-Wing Configurations; Wings; Cruising Flight; Transport Aircraft

19980056101

Multiobjective optimization of a commercial transport aircraft for cost and weight

Crossley, William A., Purdue Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0911; Copyright; Avail: Aeroplus Dispatch

This paper discusses the optimization of a small, medium-range transport aircraft to minimize direct operating cost, gross weight, and a combination of these two objectives. An effective method for cost optimization of aircraft is desired, especially in the commercial sector where many decisions are cost-driven. In the past, many conceptual and preliminary design efforts have assumed a direct relationship between gross weight and cost. However, this relationship is not necessarily the case. The methodology used here for cost prediction incorporates several inputs, not just gross weight. The optimization algorithm CONMIN is used for minimization of the single-objective and multiobjective functions. The design variables are wing loading, thrust-to-weight ratio, aspect ratio, wing sweep, and wing taper ratio. Constraints are imposed on takeoff distance, cruise speed, rate of climb, landing distance, and absolute ceiling. Weighted objectives and a gaming theory are both used as approaches to the multiobjective problem. Results of the optimization studies are presented and discussed.

Author (AIAA)

Optimization; Commercial Aircraft; Transport Aircraft; Cost Analysis; Weight Reduction; Aircraft Design

19980056102

A stochastic approach to multi-disciplinary aircraft analysis and design

Mavris, Dimitri N., Georgia Inst. of Technology, Atlanta, USA; DeLaurentis, Daniel A., Georgia Inst. of Technology, Atlanta; Bandte, Oliver, Georgia Inst. of Technology, Atlanta; Hale, Mark A., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Contract(s)/Grant(s): NAG1-1793; NAG2-1047

Report No.(s): AIAA Paper 98-0912; Copyright; Avail: Aeroplus Dispatch

Within the context of multidisciplinary aircraft analysis and design, a new approach has been formulated and described which allows for the rapid technical feasibility and economic viability assessment of multiattribute, multiconstrained designs. The approach, Virtual Stochastic Life Cycle Design, facilitates the multidisciplinary consideration of a system, accounting for life-cycle issues in a stochastic fashion. The life-cycle consideration is deemed essential in order to evaluate the emerging, all encompassing system objective of affordability. The stochastic treatment is employed to account for the knowledge variation/uncertainty that occurs in time through the various phases of design. Variability found in the treatment of assumptions, ambiguous requirements, code fidelity (imprecision), economic uncertainty, and technological risk are all examples of categories of uncertainty that the proposed probabilistic approach can assess. For cases where the problem is overconstrained and a feasible solution is not possible, the proposed method facilitates the identification and provides guidance in the determination of potential barriers which will have to be overcome via the infusion of new technologies.

Author (AIAA)

Stochastic Processes; Aircraft Design

19980056451

2GCHAS prediction of HART blade-vortex interaction loading

Lim, Joon W., NASA Ames Research Center, USA; Tung, Chee, NASA Ames Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Analytical predictions of blade vortex interaction (BVI) loading are presented for the 40 percent, Mach-scaled model of the hingeless BO-105 main rotor (HART). The main analytical tool used was the 2GCHAS software, but CAMRAD/JA and full potential rotor (FPR) code predictions are also presented. Correlation includes blade frequencies, blade tip deflections, BVI air-

loads, and tip vortex geometries. The 2GCHAS free wake analysis results include the Scully wake and the Maryland Free Wake (MFW) models. The Maryland Free Wake model was successfully coupled in 2GCHAS, and showed a similar level of accuracy in BVI predictions compared with the 2GCHAS Scully wake. Overall, the 2GCHAS BVI load predictions using the Scully wake and the Maryland Free Wake (MFW) models were slightly better than CAMRAD/JA. Modeling the secondary vortex wake in the MFW model improved the BVI loads prediction. The 2GCHAS Scully wake model captured the HF BVI loading, while the 2GCHAS Maryland Free Wake model did not. The use of the MFW model (version 2) in 2GCHAS increases the CPU time by 23-56 times compared with the 2GCHAS Scully wake model.
Author (AIAA)
BO-105 Helicopter; Blade-Vortex Interaction; Noise Prediction (Aircraft); Rigid Rotor Helicopters; Aerodynamic Loads

19980056460

Active vibration control procedure to reduce internal noise of helicopter cabin

Simon, F., ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Pauzin, S., ONERA, Centre d'Etudes et de Recherches de Toulouse, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The paper deals with the feasability of a structural active control procedure in order to reduce the radiated noise generated in a helicopter cabin, through the mechanical deck and the trim panel, by the vibration of the gearbox. A damped anisotropic panel, composed of a core in Nomex honeycomb and fiberglass layers, is excited by a shaker (primary source) and radiates into a receiving room. A predictive model of the vibroacoustic behavior of a plane panel fitted with local (shakers) and distributed (piezoceramics) actuators is presented. The displacement fields points out membrane, bending, and shear effects with the continuity of displacements and shear stresses. The simulations make it possible to understand phenomena, depending on the modal density, and to choose the number and the location of actuators and of error sensors. The contribution of each mode, in the total radiation, is analyzed, assuming the free field propagation. A parametrical study concerns sinusoidal excitations applied for different modal densities. It is shown that the high value of structural damping, representative of this type of structure, is an important parameter.
Author (AIAA)
Helicopter Control; Noise Reduction; Vibration Damping; Active Control; Aircraft Compartments

19980056465

A comparison of measured and predicted XV-15 tiltrotor surface acoustic pressures

Lyle, Karen H., U.S. Army, Vehicle Technology Center, USA; Burley, Casey L., NASA Langley Research Center, USA; Prichard, Devon S., Lockheed Martin Engineering & Sciences, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Predicted XV-15 exterior surface acoustic pressures are compared with previously published experimental data. Surface acoustic pressure transducers were concentrated near the tip-path-plane of the rotor in airplane mode. The comparison emphasized cruise conditions which are of interest for tiltrotor interior noise level flight for speeds ranging from 72 to 113 m/s. The predictions were produced by components of the NASA/Langley Tiltrotor Aeroacoustic Code (TRAC) system of computer codes. Comparisons between measurements and predictions were made in both the time and frequency domains, as well as overall sound pressure levels. In general, the predictions replicated the measured data well. Discrepancies between measurements and predictions were noted. Some of the discrepancies were due to poor correlation of the measured data with the rotor tach signal. In other cases limitations of the predictive methodology have been indicated.
Author (AIAA)
XV-15 Aircraft; Tilt Rotor Aircraft; Sound Pressure; Pressure; Noise Prediction (Aircraft); Aircraft Noise

19980056471

The development and flight test demonstration of noise abatement approach procedures for the Sikorsky S-76

Jacobs, Eric W., Sikorsky Aircraft, USA; Prillwitz, Ronald D., Sikorsky Aircraft, USA; Chen, Robert T. N., NASA Ames Research Center, USA; Hindson, William S., NASA Ames Research Center, USA; Santa Maria, Odilyn L., NASA Langley Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A joint U.S. Industry/NASA/FAA program was conducted during 1996 to develop and flight test validate noise abatement flight procedures for rotorcraft using Differential GPS technology for pilot guidance. Program participants included Boeing-Mesa, Sikorsky Aircraft Corporation, NASA/Ames, NASA/Research Center and the Volpe National Transportation Systems Center (DOT/FAA). Key issues included potential noise reduction benefits, flyability, repeatability, passenger and crew acceptability, and potential regulatory approval. The current paper summarizes the development and flight test demonstration of noise abate-

ment approaches for the S-76. Noise reductions exceeding 6 dB were demonstrated and improved. 'Fly neighborly' approach conditions are identified.
Author (AIAA)
Flight Tests; Noise Reduction

19980056473

Development and demonstration of noise abatement approach flight operations for a light twin-engine helicopter - MD Explorer

Jankai Ram, Ram D., Boeing Co., USA; O'Connell, James M., Boeing Co., USA; Fredrickson, Daphne E., Boeing Co., USA; Conner, David, U.S. Army, Joint Research Program Office, USA; Rutledge, Charles K., Lockheed Martin Engineering & Sciences, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Under the sponsorship of the National Rotorcraft Technology Center (NRTC), a team of two helicopter manufacturers and three Government research and test centers conducted a four-week flight test program at Crow's Landing, CA, in late 1996. The program objective was to develop and successfully demonstrate low noise approach flight operations for two helicopters (MD Explorer and S-76B) using modern guidance and tracking systems. The combined resources of all the team members allowed the acquisition of acoustic data at 55 microphone locations under the flight path spanning an area of 8000 by 3000 feet. This array of microphones made it possible to obtain acoustic footprints over a wide area under the descending helicopter flight path. As part of the flight test program, the Boeing Company in Mesa selected and tested its modern light twin-engine helicopter, the MD Explorer. A low cost pilot guidance system based on a Differential GPS was developed, installed in the MD Explorer, and used to guide the helicopter for all the approach flight profiles. Measured flight profile data presented for four typical approach flights show that the pilot was able to maintain vertical and lateral deviations within 20 to 30 feet of the target flight paths and airspeed within 3 to 4 kts of the target speed profile.
Author (AIAA)
Helicopter Engines; Engine Noise; Noise Reduction; Flight Tests; Airspeed; Flight Paths

19980056492

Development and validation of a finite state in-ground effect inflow model for lifting rotors

Prasad, J. V. R., Georgia Inst. of Technology, Atlanta, USA; Xin, Hong, Georgia Inst. of Technology, Atlanta; Peters, D. A., Washington Univ., USA; Nagashima, T., National Defense Academy, Japan; Iboshi, N., National Defense Academy, Japan; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A new ground effect model which is motivated by the generalized inflow theory is proposed. The total pressure potential in the flow field is expressed as a superposition of the contribution from the rotor and that from the ground surface, and each can be expressed as a series of normalized associated Legendre functions in two different ellipsoidal coordinate systems. For the ground pressure potential, the magnitude of each term is determined by satisfying the nonpenetration boundary condition at the ground surface. An analytical expression for the mass flow parameter as a function of rotor height above the ground surface is obtained. by introducing this height-dependent mass flow parameter, induced velocity at the rotor disk can be determined in the same formulation as the generalized dynamic wake theory. Initial validation with experimental results demonstrate the validity of the proposed model.
Author (AIAA)
Ground Effect (Aerodynamics); Lifting Bodies; Rotor Aerodynamics; Flow Characteristics; Aircraft Wakes

19980056493

An experimental study of a rotor in axial flight

Caradonna, F., U.S. Army, Aeroflightdynamics Directorate, USA; Henley, E., U.S. Army, Aeroflightdynamics Directorate, USA; Silva, M., U.S. Army, Aeroflightdynamics Directorate, USA; Huang, S., U.S. Army, Aeroflightdynamics Directorate, USA; Komerath, N., Georgia Inst. of Technology, Atlanta; Reddy, U., Georgia Inst. of Technology, Atlanta; Mahalingam, R., Georgia Inst. of Technology, Atlanta; Funk, R., Georgia Inst. of Technology, Atlanta; Wong, O., Georgia Inst. of Technology, Atlanta; Ames, R., Georgia Inst. of Technology, Atlanta; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper studies the concept of extracting hover performance from model rotor climb data by extrapolating to the limit of zero climb speed. A two-bladed rotor is mounted horizontally and tested in the 30 x 31-ft settling chamber of the Ames 7 x 10-ft no. 1 wind tunnel. The collective pitch and tunnel speed are varied. CCD video cameras are used to visualize the flow field illuminated by pulsed white light sheets. Facility recirculation effects are eliminated at all but the lowest advance ratios. With a steady, nonrecirculatory flow, the rotor wake is seen to be fully periodic, with little diffusion and dissipation of the vortices for several rotor cycles. The transition to the far wake is seen to occur through a periodic pairing of the tip vortices, followed by their merging

into a single diffuse vortex for each rotor cycle. The number of discrete vortex turns in the near wake before the pairing varies with the thrust coefficient and advance ratio. The climb-extrapolation method appears to be a reliable and practical approach to obtaining performance data that are free of recirculation or facility effects.
Author (AIAA)
Rotor Aerodynamics; Rotor Blades; Climbing Flight; Wind Tunnel Tests; Pitching Moments

19980056657
Accelerated quality maturity
Aerospace Engineering; Feb. 1998; ISSN 0736-2536; Volume 18, n, nos. 1-2, pp. 28, 29; In English; Copyright; Avail: Aeroplus Dispatch

The activities associated with the introduction of the Boeing 777 aircraft encompassed the achievement of initial service readiness, entailing the study of several approaches to early quality maturity for avionics. The selected approach applied elevated levels of environmental stress in the laboratory to a functioning test component in incremental steps until a failure that would indicate a latent defect which would eventually have been noticed in normal service.
AIAA
Boeing 777 Aircraft; Aircraft Performance; Q Factors; Avionics; Environmental Tests

19980056663
757 flying testbed to serve as 30-seat F-22
Proctor, Paul, USA; Aviation Week & Space Technology; Jan. 05, 1998; ISSN 0005-2175; Volume 14, no. 1, pp. 32, 33; In English; Copyright; Avail: Aeroplus Dispatch

Boeings's flying testbed (FTB) 757 will be fitted with an F-22 forward fuselage section and representative wing. The aim of the FTB platform is the saving of millions of dollars in test flight hours by allowing the preflight and debugging of critical F-22 electronic systems in a real-time, dynamic environment. Attention is given to the FTB's instrumented interiors.
AIAA
Boeing 757 Aircraft; Test Equipment; F-22 Aircraft; Fuselages; Display Devices; Cockpits

19980057032
Schweizer RU-38A Twin-Condor - Covert surveillance aircraft
O'Toole, Michael J., Integrated Aerosystems, Inc., USA; Schweizer, Paul H., Schweizer Aircraft Corp., USA; 1997, pp. 29-39; In English; Copyright; Avail: Aeroplus Dispatch

There is a growing requirement for airborne platforms that can covertly perform surveillance missions during either day or night and in a cost effective manner. to meet this need, Schweizer Aircraft has recently developed the RU-38A twin-engine surveillance aircraft. This paper discusses the evolution and principle design concepts of this aircraft and how its unique performance enables the RU-38A to achieve new levels of surveillance capability.
Author (AIAA)
Reconnaissance Aircraft; Surveillance; Low Noise; International Relations; Security

19980057168
Strengths of heat resistant thermoplastic composites (IM-7/PIXA) for future high speed civil transport
Ishikawa, Takashi, National Aerospace Lab., Japan; Matsushima, Masamichi, National Aerospace Lab., Japan; Hayashi, Yoichi, Foundation of Japan Aerospace Technology, Sendai; Nakamura, Hiroyuki, Fuji Heavy Industries, Ltd., Japan; 1997, pp. 1137-1142; In English; Copyright; Avail: Aeroplus Dispatch

The most important technology for future high speed civil transport (HSCT) in Mach range 2.0-2.4 is heat resistant polymer composites with high toughness for dramatic weight reduction in a vehicle structure. One of the candidate composite systems is carbon fiber (CF)/PIXA, which is a new thermoplastic polyimide resin developed in Japan. Composite strength properties of this system using IM-7 fibers were measured in several test methods for preliminary structural design. Compression strength after impact (CAI) is one of the crucial strength measures in composites, particularly for airframe damage tolerance. CAI values of the present system were obtained at room and several elevated temperatures and compared with the corresponding CAI values for CF/5260 bis-maleimide composites. CAI values of IM-7/PIXA are better than those of CF/5260, particularly over 200 C. CAI and other strength data indicate the potential of this material for future HSCT structures.
Author (AIAA)
Thermoplastic Resins; Shear Strength; Tensile Strength; Compressive Strength; Polymer Matrix Composites

19980057175

A certification plan of composite control surfaces for basic trainer aircraft

Oh, Hee-Seok, Agency for Defense Development, Republic of Korea; Jun, Seung-Moon, Agency for Defense Development, Republic of Korea; Han, Young-Myong, Agency for Defense Development, Republic of Korea; 1997, pp. 1177-1182; In English; Copyright; Avail: Aeroplus Dispatch

This paper delineates a certification plan for composite control surfaces for basic trainer aircraft. The certification plan for composite aircraft structures is regarded as one of great importance for the design and analysis of composite structures. The certification plan for composite aircraft structures is prepared to define the overall procedure and methodology on how to comply with the applicable requirements for certification. The FAA Advisory Circular 20-107 A is used as a guide for the certification plan preparation. The environmental effects, damages, repeated loading, and in-service repairs are considered as design criteria for the composite control surfaces. The critical conditions and procedures are defined for the design criteria. The substantiation is performed through static strength analysis and substantiation test.

Author (AIAA)

Certification; Control Surfaces; Training Aircraft; Composite Structures

19980057292

Helicopter horizontal stabilizer in fiber reinforced thermoplastics - Low cost design

Offringa, Arnt, Fokker Special Products BV, Netherlands; Journal of Advanced Materials; Jul. 1997; ISSN 1070-9789; Volume 28, no. 4, pp. 2-7; In English; Copyright; Avail: Aeroplus Dispatch

A design and manufacturing study has been carried out on a three meter span transport helicopter horizontal stabilizer. The goal of the study was to prove cost-effectiveness of a thermoplastic in lieu of the standard thermoset composite. Based on a list of requirements, a number of concepts were drafted. Two of these, one blade stiffened and the other sandwich, were refined. The carbon/PEI sandwich concept proved best suited, with lowest cost and weight. Component cost proved to be significantly lower as compared to the baseline thermoset design. This result is achieved mainly by the application of resistance welding, used in all of the load carrying torsion box. Rivets were effectively eliminated. Thermoset composite material was used in specific areas such as the nose section and on the inside of sandwich skin panels. A next step, pending validation of key thermoplastics technology, such as the welding technique, will be the detail design phase. This design and manufacturing study has confirmed the feasibility of cost-effective design using thermoplastic manufacturing technology.

Author (AIAA)

Helicopter Design; Design to Cost; Stabilizers (Fluid Dynamics); Carbon Fiber Reinforced Plastics; Sandwich Structures; Thermoplastic Resins

19980057811

1997 report to the aerospace profession - Society of Experimental Test Pilots, Symposium, 41st, Beverly Hills, CA, Sept. 25, 26, 1997, Proceedings

1997; In English

Report No.(s): ISSN 0742-3705; Copyright; Avail: Aeroplus Dispatch

Various papers on flight testing are presented. Individual topics addressed include: F/A-18E/F high-AOA testing update, F/A-18E/F initial sea trials, low-cost design and flight testing of the T-38 inlet, B-1B weapons conventionalization, flight test overview of the status of the SJ30-2, how to make a heavy aircraft weightless, IDF flight test program overview, investigation of display handling qualities in F-16 database terrain cueing, CH-46 blade stall during the conduct of dynamic component upgade and fuselage strain survey tests, digital transformation of the F-14B, flight testing in A/C upgrade programs, airfield performance testing of the EH101 three-engine helicopter, initial engine relight test on Eurofighter 2000, Flight Test Safety Committee update, and automatic VMC protection in the C-130J. Also discussed are: pilot recognition of the F/A-18 falling leaf mode, recent advances in Spin/Stall Recovery Parachute System technology, first flight preparation and testing the F-22A Raptor, F-16 stability and control certification testing with digital flight control system improvements, development of nuisance warning criteria for ground collision avoidance systems, meeting the UK’s future STOVL recovery requirements, test pilot’s perspective on X-36 flight tests, development and certification of the Citation X 0.9+ Mach business jet, progress report on the RAH-66 Comanche flight test, B-2A residual pitch oscillation investigation, and air power in the modern world.

AIAA

Conferences; Flight Safety; Escape Systems; Aircraft Equipment; Aircraft Design

19980057812

F/A-18E/F high AOA testing update

Madenwald, Fred, Boeing Co., USA; Heller, Mike, Boeing Co., USA; Niewoehner, Rob, U.S. Navy, USA; 1997, pp. 5-13; In English; Copyright; Avail: Aeroplus Dispatch

The high-AOA flight test approaches and results for the F/A-18E/F aircraft are discussed. Strengths and deficiencies of the aircraft during Phase 1, which involved mild maneuvers, Phase II, which consisted of quick looks at upright spin entry and recovery, inverted spin entry and reocvery, and falling leaf entry and recovery, and phase III which involved worst-case inputs, are reported. Results from the limited high-AOA testing done on a two-place aircraft and plans for future testing are briefly considered.

AIAA

F-18 Aircraft; Flight Tests; Aircraft Maneuvers; Flight Characteristics

19980057813

F/A-18E/F initial sea trials

Gurney, Tom, U.S. Navy, USA; Morley, Frank, U.S. Navy, USA; 1997, pp. 14-20; In English; Copyright; Avail: Aeroplus Dispatch

Initial sea trials of the F/A-18E/F, intended to provide an early assessment of the aircraft in the carrier environment, are discussed. Catapult tests, arrested landing tests, and reduced authority thrust system tests are reviewed.

AIAA

F-18 Aircraft; Flight Tests; Ocean Surface; Catapults; Water Landing

19980057814

A low-cost design and flight test of the T-38 inlet

Johnson, Greg, NASA Johnson Space Center, USA; Ess, Robert, NASA Johnson Space Center, USA; 1997, pp. 21-45; In English; Copyright; Avail: Aeroplus Dispatch

An inlet redesign of the T-38 was completed and flight tested by NASA Johnson Space Center (JSC). The redesign will allow full gross weight takeoffs from high altitude airports such as El Paso, TX with runway temperatures up to 99 degrees F, an increase of 9 degrees F over the current performance. This project was completed in-house using innovative test techniques. The static thrust of the T-38 was increased 20 percent with this new inlet.

Author (AIAA)

T-38 Aircraft; Flight Tests; Design to Cost; Engine Inlets; Aircraft Design; Static Thrust

19980057816

Status of the SJ30-2 - Flight test overview

Beeler, Carroll, Sino Swearingen Aircraft Co., USA; 1997, pp. 63-89; In English; Copyright; Avail: Aeroplus Dispatch

A brief overview is given of the flight test development program of the SJ30-2, a lightweight, entry-level, efficient business class jet aircraft. The key features, aerodynamics, and systems of the aircraft are described.

AIAA

Light Aircraft; Flight Tests; Jet Aircraft; Aerodynamic Characteristics

19980057817

How to make a heavy aircraft weightless

Poisson, Didier, Centre d'Essais en Vol, France; Gasparini, Jean-Marc, Centre d'Essais en Vol, France; Cartier, Michel, Centre d'Essais en Vol, France; 1997, pp. 90-102; In English; Copyright; Avail: Aeroplus Dispatch

Flight tests of the Airbus A 300 in parabolic flight where the aircraft is subjected only to its own weight are reviewed. The tests helped understand aircraft vibration, resulted in an optimal flight parabola outside the vibration range of speed, opened the parabola's flight envelope, and showed that a sequence of 32 parabolas could be flown within commercial requirements.

AIAA

European Airbus; Weight Reduction; Flight Tests; Parabolic Flight; Flight Optimization

19980057818

IDF flight test program overview

Chu, Charles, Aerospace Industrial Development Corp., Taiwan, Province of China; Wueng, Fwu-Lai, Aerospace Industrial Development Corp., Taiwan, Province of China; 1997, pp. 103-114; In English; Copyright; Avail: Aeroplus Dispatch

The Indigenous Defensive Fighter (IDF) is the first advanced fighter built in Taiwan, Republic of China, specifically designed to take advantage of the most advanced technology available including both digital flight control system and advanced avionics system. Over 2600 test flights have been conducted during the last eight years using four full-scale development test aircraft. With so much new design technology and the need for new test flight concepts to be developed, it was inevitable that several design faults would and were identified during flight test maneuvers. This resulted in both the flight test team and the designer group benefiting greatly from the experience gained in system design/integration, flight test planning, and problem solving.
Author (AIAA)
Flight Tests; Fighter Aircraft; Defense Program; Flight Control; Full Scale Tests; Aircraft Design

19980057820
CH-46 blade stall during the conduct of dynamic component upgrade and fuselage strain survey tests
L'Heureux, Mike, USMC, Naval Rotary Wing Aircraft Test Squadron, USA; 1997, pp. 136-150; In English; Copyright; Avail: Aeroplus Dispatch

This paper examines an in-flight blade stall occurrence during the conduct of aircraft testing of the CH-46 Sea Knight helicopter at Naval Air Warfare Center. The paper provides the background to the tests, a short synopsis of the events leading up to the stall event, a brief description of the event itself, and a description of the team response, follow-on actions, lessons learned, and team recommendations.
Author (AIAA)
CH-46 Helicopter; Rotor Blades; Aerodynamic Stalling; Fuselages; Strain Distribution; Flight Tests

19980057821
The digital transformation of the F-14B
Martins, John, U.S. Navy, Naval Weapons Test Squadron, USA; 1997, pp. 151-165; In English; Copyright; Avail: Aeroplus Dispatch

This paper outlines how the F-14B's entire old-fashioned avionics architecture was successfully gutted and replaced with a modern digital data bus system. The focus is on lessons learned during the F-14B upgrade program over the project's life from inception to fleet introduction.
AIAA
F-14 Aircraft; Digital Data; Avionics; Architecture (Computers)

19980057823
EH-101 airfield performance testing of a three-engine helicopter
Swales, Michael R., GKN Westland Helicopters, UK; 1997, pp. 183-210; In English; Copyright; Avail: Aeroplus Dispatch

In November 1994, the EH101 was the first helicopter to achieve simultaneously a preliminary Type Certification from three airworthiness agencies, the UK CAA, the FAA, and the Italian RAI. In continuation of the full certification process, an airfield performance trial was conducted at the EH 101 production facility of Vergiate, near Milan, Italy during the summer of 1996. Fifty-five hours were flown evaluating the handling and performance of the helicopter in Category A takeoff and landing profiles and in ground-level heliport operations. This paper discusses these tests, emphasizing the idiosyncracies of the three-engine configuration and the choice of techniques flown. Results are presented which match a mathematical model from a Helicopter Airfield Performance Simulation (HAPS) program to actual performance achieved. After a satisfactory correlation is obtained, then HAPS will be used to generate the Flight Manual dynamic performance charts.
Author (AIAA)
Eh-101 Helicopter; Airfield Surface Movements; Aircraft Engines; Aircraft Reliability; Helicopter Performance; Heliports

19980057827
Recent advances in Spin/Stall Recovery Parachute System technology
Taylor, Anthony P., Irvin Aerospace, Inc., USA; Delurgio, Phillip R., Irvin Aerospace, Inc., USA; 1997, pp. 267-283; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents recent advances in Spin/Stall Recovery Parachute System (SSRPS) technology, as advanced by Irvin Aerospace Inc. and its customers. Specific discussions focus on the value of providing the entire system rather than piece parts and the development of SSRPS controls which are simple and intuitive, incorporation of built-in test, some simple rules for sizing SSRPS's for commercial aircraft, and the use of digital simulations for analysis of aircraft recovery.
Author (AIAA)
Recovery Parachutes; Spin Stabilization; Aerodynamic Stalling; Commercial Aircraft; Flight Control

19980057828

First flight preparation and testing the F-22A Raptor

Metz, Paul, Lockheed Martin Aeronautical Systems, USA; 1997, pp. 284-289; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the mission control room and aircrew training leading up to the first flight of the F-22A Raptor. The flight itself, the initial evaluation of the aircraft, and lessons learned to date are examined.

Author (AIAA)

F-22 Aircraft; Flight Characteristics; Flight Control; Training Evaluation; Flight Crews; Aircraft Performance

19980057832

Flight testing the X-36 - The test pilot's perspective

Walker, Laurence A., Boeing AS&T Phantom Works, USA; 1997, pp. 338-348; In English; Copyright; Avail: Aeroplus Dispatch

Flight test demonstrations of the X-36 tailless stealth aircraft are reviewed. The aircraft is described and the flight tests are recounted from the pilot's point of view. The lessons learned are briefly considered.

AIAA

X-36 Aircraft; Flight Tests; Aircraft Pilots; Aircraft Performance

19980057833

Citation X - Development and certification of a 0.9 Mach+ business jet

Schlegel, Mark O., Cessna Aircraft Co., USA; 1997, pp. 349-368; In English; Copyright; Avail: Aeroplus Dispatch

Flight test highlights of the Citation X, which is intended to be the first business jet to cruise at 0.88 Mach, with a maximum speed of 0.90 Mach, are reviewed. Pitot-static/dive/reduced vertical separation minimum tests, stalls, static/dynamic stability, aircraft performance are examined. The aircraft avionics is described.

AIAA

Jet Aircraft; Flight Tests; Cruising Flight; Aerodynamic Stability; Vertical Flight; Static Stability

19980057834

Progress report - RAH-66 Comanche flight test

Stiles, Lorren, Sikorsky Aircraft, USA; Murrell, Reginald, Boeing Helicopters, USA; Armbrust, John; 1997, pp. 369-392; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents unique aspects of the RAH-66 Comanche aircraft and test program, including the unique technologies incorporated into the design, the tools used by the program to achieve progress in the development of the aircraft in the current restricted fiscal environment, and the accomplishments of the flight test program. The paper also defines future development plans for the aircraft.

AIAA

Aircraft Design; Flight Tests; Technological Forecasting; Flight Plans; Aircraft Performance

19980058351

Analysis and testing of a Froude scaled helicopter rotor with piezoelectric bender actuated trailing edge flaps

Koratkar, Nikhil A., Maryland, Univ., College Park, USA; Chopra, Inderjit, Maryland, Univ., College Park; Journal of Intelligent Material Systems and Structures; Jul. 1997; ISSN 1045-389X; Volume 8,, no. 7, pp. 555-570; In English

Contract(s)/Grant(s): DAAH04-96-10334; Copyright; Avail: Aeroplus Dispatch

This paper presents an analytical model and validation tests of a Froude scaled rotor featuring piezoelectric bender (bimorph)-actuated trailing-edge flaps for active vibration suppression. The analytical model for the coupled bimorph actuator trailing-edge flap dynamic response in the rotating environment takes into account the aerodynamic, centrifugal, inertial, and frictional loads acting on the actuator-flap system. The linkage arm length associated with the mechanical amplification mechanism is selected to maximize flap performance in the rotating environment. The bimorph clamping is improved to prevent actuator slippage under high centrifugal loads. The analytical model is validated by carrying out a series of bench tests, vacuum chamber tests, and hover tests. In hover, flap deflections of +/-6 deg at 4/rev flap excitation are achieved at 900 rpm, thus demonstrating the potential of the piezoceramic bender as a lightweight and compact actuation system for individual blade control purposes. This paper also includes a feasibility study for piezo-bimorph actuation of a trailing-edge flap for a Mach scaled rotor model.

Author (AIAA)

Froude Number; Rotary Wings; Trailing Edge Flaps; Vibration Damping; Piezoelectric Transducers; Actuators; Dynamic Tests; Rotor Dynamics; Dynamic Response

19980058484

Effects of blade elasticity on open and closed loop higher harmonic control of a hingeless helicopter rotor ***Einfluss der Blattelastizitaet auf die hoeherharmonische Steuerung und Regelung eines gelenklosen Hubschrauberrotors***

Kube, Roland, Braunschweig, Technische Univ., Germany; 1997; In German

Report No.(s): ISSN 0939-2963; Copyright; Avail: Aeroplus Dispatch

Based on wind tunnel data and numerical simulation results, the effects of different higher harmonic blade pitch combinations are determined. For the blade pitch angle showing the highest efficiency, an adaptive closed loop controller is derived and optimized with respect to response time by systematically varying its parameters. Constant feedback gains which are valid for the complete flight and operational envelope are determined by applying a design procedure from which stability of the closed loop system can be expected even when the rotor reaction to higher harmonic blade pitch inputs varies with rotor condition and operating point. It is demonstrated that the resulting fixed gain controller works stable and shows a shorter response time than the adaptive one.

Author (AIAA)

Rigid Rotor Helicopters; Rotor Blades; Harmonic Control; Elastic Bodies; Feedback Control; Control Systems Design

19980060231

Post-impact behaviour of aerospace composites for high-temperature applications: experiments and simulations

Sala, Giuseppe, Politecnico di Milano, Italy; Composites Part B:Engineering; 1997; ISSN 1359-8368; Volume 28, no. 5-6, pp. 651-665; In English; Copyright; Avail: Issuing Activity

The post-impact performance of conventional epoxy, high-temperature curing epoxy and epoxy-isocyanate were studied experimentally and analytically. Experimental testing consisted of impacting rectangular specimens at different energy levels by using a spring-driven impact apparatus. After impact, coupons were nondestructively inspected by means of opaque-enhanced dye-penetrant X-radiography and tested in static compression to correlate impact energy, damage extent and residual strength.

EI

Aerospace Engineering; High Temperature; Polymer Matrix Composites; Carbon Fiber Reinforced Plastics; Impact Tests; Matrix Materials; Thermosetting Resins

19980060895

Compound helicopter configuration and the helicopter speed trap

Newman, Simon, Univ. of Southampton, UK; Aircraft Engineering and Aerospace Technology; 1997; ISSN 0002-2667; Volume 69, no. 5, pp. 407-413; In English; Copyright; Avail: Issuing Activity

Explains the origins of rotor aerodynamic limits for helicopters including retreating and advancing blade limits. Examines the compounding of a helicopter for higher forward speed and reports the conclusions of a student project to design a rotorcraft capable of 300 knots and carrying a payload of 30 passengers.

Author (EI)

Compound Helicopters; Rotary Wings; Aerodynamics

19980060896

UK Ministry of Defence generic health and usage monitoring system (GenHUMS)

Trammel, Chuck, Smiths Industries, USA; Vossler, Gerry; Feldmann, Mike; Aircraft Engineering and Aerospace Technology; 1997; ISSN 0002-2667; Volume 69, no. 5, pp. 414-422; In English; Copyright; Avail: Issuing Activity

Smiths Industries Aerospace (SI) offers a multi-aircraft capable generic health and usage monitoring system (GenHUMS) using field proven, off-the-shelf, airborne and ground-based technology. The UK Ministry of Defence (MoD) has selected the GenHUMS for the Chinook aircraft with additional options for Puma, Sea King and Lynx aircraft. The GenHUMS provides all conventional HUMS functionality, and incorporates key innovation in the areas of rotor track and balance, failure detection, flight regime recognition, alert generation, system configurability, and user interface. The architecture is unique in that all required airborne data acquisition and processing, including crash survivable cockpit voice and flight data recording, are combined in a single line replaceable unit. This architecture significantly reduces space, weight and power requirements and results in the highest reliability, least risk, lowest life cycle cost, HUMS known today. Fixed and portable PC-based HUMS ground stations provide configurable, user friendly, data extraction and analysis capabilities.

Author (EI)

Rotary Wings; Helicopters; Human-Computer Interface; Data Acquisition; Service Life; Reliability

19980060897

Helicopter simulation

Ford, Terry, British Aerospace, UK; Aircraft Engineering and Aerospace Technology; 1997; ISSN 0002-2667; Volume 69, no. 5, pp. 423-427; In English; Copyright; Avail: Issuing Activity

Details the latest developments in helicopter simulation, as revealed at a recent conference, and how they might help in reducing the costs associated with training pilots. Discusses in depth the Merlin Training System, an integrated set of training devices which feature simulators, part task trainers and classroom and computer based training materials. Also examines other training solutions for civil and military helicopters, such as Heli-Trainer from Thomson Training and Simulation.

Author (EI)

Helicopters; Flight Simulators; Personnel Development; Cost Effectiveness

19980060901

Advances in rotorcraft

Ford, Terry, British Aerospace, UK; Aircraft Engineering and Aerospace Technology; 1997; ISSN 0002-2667; Volume 69, no. 5, pp. 447-454; In English; Copyright; Avail: Issuing Activity

Reviews recent advances in rotorcraft technology as presented at a recent Royal Aeronautical Society conference on innovation in rotorcraft technology and the 1997 Paris Air Show. Reports research initiatives to improve key rotorcraft technologies in the areas of obstacle detection, vibration and noise reduction and smart structures. Also mentions advances in overcoming rotorcraft speed limitations through use of tiltrotor and tiltwing aircraft.

Author (EI)

Rotary Wing Aircraft; Helicopters; Collision Avoidance; Vibration Damping; Noise Reduction

19980061081

Acoustic fatigue and damping technology in FRP composites

Benchekchou, B., Univ. of Southampton, UK; White, R. G.; Composite Structures; Mar-Apr, 1997; ISSN 0263-8223; Volume 37, no. 3-4, pp. 299-309; In English; Copyright; Avail: Issuing Activity

There is considerable interest in the use of composite materials in aerospace structures. One important area is to develop a stiff, lightweight composite material with a highly damped, high-temperature polymer matrix material. This paper concerns the application of such material, in the form used in thin skin panels of aircraft, and investigates of its fatigue properties at both room and high temperature. Flexural fatigue tests have been carried out at two different temperatures and harmonic three-dimensional finite-element (FE) analyses were performed in order to understand the dynamic behavior of plates. Random acoustic excitation tests using a progressive wave tube, up to an overall sound pressure level of 162 dB, at room temperature and high temperatures were also performed in order to investigate the dynamic behavior of panels made of the materials. Parameter studies were carried out in order to examine various methods for including damping in the structure, and conclusions have been drawn concerning optimal incorporation of a highly damped matrix material into a high-performance structure.

Author (EI)

Acoustic Excitation; Acoustic Fatigue; Composite Structures; Fiber Composites; Reinforced Plastics; Matrix Materials; Aircraft Construction Materials; Panels

19980062358

Challenge well met

Warwick, Graham, USA; Flight International; Nov. 12, 1997; ISSN 0015-3710; Volume 152,, no. 4600, pp. 58-62; In English; Copyright; Avail: Aeroplus Dispatch

The design objectives of the Canadair Challenger 604 and their implementation are briefly reviewed. The Challenger, whose design has its origins in the LearStar 600, is now the furthest flying and the fastest selling Challenger ever. The 604 is the first Challenger to exceed 7,400 km range, providing true international capability for substantially less cost than that of the competing Dassault Falcon 900 and Gulfstream IV. The discussion covers the engine enhancements, overwater reliability, and the active vibration and noise control, which is available as an option.

AIAA

Aircraft Design; General Aviation Aircraft; Jet Aircraft

19980062359

Beaver revival

Norris, Guy, USA; Flight International; Nov. 12, 1997; ISSN 0015-3710; Volume 152,, no. 4600, pp. 70; In English; Copyright;

Avail: Aeroplus Dispatch

A new wing has been designed for the de Havilland DHC-2 Beaver which enables a 340-kg payload increase and improves speed, range, and short-take-off-and-landing performance. Besides the immediate benefits, the new wing is expected to be the catalyst for a large range of upgrades covering everything from wide-scale reengineering with turbine or modern reciprocating powerplants to a fuselage stretch. The design and aerodynamic improvements of the new wing are briefly reviewed.

AIAA

Aerospace Industry; Personnel; Manpower

19980062408

Navy narrows F/A-18E/F 'wing drop' options

Fulghum, David A., USA; Aviation Week & Space Technology; Jan. 19, 1998; ISSN 0005-2175; Volume 14, no. 3, pp. 29; In English; Copyright; Avail: Aeroplus Dispatch

Options for solving the U.S. Navy F/A-18E/F strikefighter's 'wing drop' problem are discussed. Any solution will likely involve an 18-in. inboard extension of the leading-edge wing snag. This bolt-on modification will be combined with either the addition of six small stall strips on top of the wings or a porous fairing over the gap where the wings fold. Any combination of options is expected to stop the tendency of the aircraft to produce uncommanded deflections of the wing during high-angle-of-attack maneuvers.

AIAA

F-18 Aircraft; Wings; Deflection

19980062529

The impact of dynamic loads on the design of military aircraft

Luber, W., Daimler-Benz Aerospace AG, Germany; Becker, J., Daimler-Benz Aerospace AG, Germany; 1998, pp. 307-327; In English; Copyright; Avail: Aeroplus Dispatch

The layout of military aircraft structures is strongly influenced by dynamic loads from the early development phase onwards up to final design and clearance phase. For some designing dynamic loads, examples are given to explain their derivation and significance both for design of aircraft structural parts and related clearance aspects. Methods to derive dynamic design loads for different applications by using analytical and experimental tools are presented. Validation methods for various design loads using dynamic model test results, as well as windtunnel model and flight test results, are presented. We indicate where dynamic loads would be dimensioning structures of future high performance combat airplanes and how to approach the problem of integrating all aspects into an optimum design.

Author (AIAA)

Dynamic Loads; Fighter Aircraft; Aircraft Design; Aircraft Structures; Structural Design; Supersonic Aircraft

19980062530

Evaluation of subspace identification techniques for the analysis of flight test data

Hermans, Luc, LMS International, Belgium; Van der Auweraer, Herman, LMS International, Belgium; Abdelghani, Maher, INRIA-IRISA, France; Guillaume, P., Brussel, Vrije Univ., Belgium; 1998, pp. 300-306; In English; Copyright; Avail: Aeroplus Dispatch

A stochastic subspace method, referred to as Canonical Variate Analysis (CVA), is briefly discussed and subsequently applied to flight flutter test data. Practical aspects, such as the model order selection and the distinction between the spurious modes and the physical modes, are outlined. The results obtained with the stochastic subspace technique are compared with the estimates of the Polyreference LSCE method fed by correlation functions instead of impulse response functions. The Maximum Likelihood Estimator, a frequency domain input-output modeling technique, is used to establish a reference model for the evaluation of the accuracy of the output-only techniques.

Author (AIAA)

Flight Tests; In-Flight Monitoring; Flight Safety; Maximum Likelihood Estimates

19980062531

Flutter prediction on a combat aircraft involving backlash on control surfaces

Luber, W. G., Daimler-Benz Aerospace AG, Germany; 1998, pp. 291-299; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the results of an analytical effort conducted to determine the effects of backlash on bearings of control surfaces and failures of actuators on the flutter mechanism. The investigation was made on a multirole combat aircraft with conventional vertical tail (backlash between fin and rudder) and an all-movable taileron (backlash in pitch and roll). Findings from

ground tests, such as backlash measurements, are presented, and an explanation for these test results is given. Calculations with linear stiffness assumptions and parameter variations are made, and in the wing pivot backlash investigation, the method of harmonic balance for calculating these parameters is applied. From the results of ground testing, flutter calculations are performed by separate variations of the theoretical actuator stiffness of the two control surfaces. Sub and supersonic flutter calculations show the influence of stiffness reduction due to actuator failures or exceeded backlash. The analysis indicates that the reduction of stiffness as a result of friction or backlash and/or actuator failures could have detrimental effects on flutter stability in the control surface rotation mode.
Author (AIAA)
Flutter Analysis; Fighter Aircraft; Control Surfaces; Flight Control

19980062637

Real-time animation of aircraft mounting structure

Tappert, Peter M., Hood Technology Corp., USA; 1998, pp. 1416-1419; In English; Copyright; Avail: Aeroplus Dispatch

Hood Technology Corporation has developed a MATLAB routine, which is integrated in DSPT's SigLab (Signal/Network Analysis hardware with MATLAB Graphical User interface), in order to animate the motion of engine yokes at the two fundamental frequencies of excitation of an aircraft's engines. The aircraft mounting structure animation routine was useful in the development and evaluation of Barry Controls' ATMA noise suppression system for Douglas twin-jet aircraft. This paper describes this routine and its use.
Author (AIAA)
Real Time Operation; Computer Animation; Aircraft Structures; Aircraft Noise

19980062712

Strain modal testing of a helicopter tail boom

Uhl, T., Univ. of Mining and Metallurgy, Poland; Lisowski, W., Univ. of Mining and Metallurgy, Poland; Malecki, J., PZL Swidnik S.A., Poland; 1998, pp. 1271-1277; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports current stage of the research whose aim is to apply computer-aided testing and modelling technique in order to aid the helicopters structural dynamics properties investigation methodology. The considered approach might be useful for application to helicopters design formulation, prototyping, and modification, technical state monitoring and prediction, and assembly quality control. The state of the art of the helicopters structural dynamics investigations is surveyed and some results application directions are discussed. The main results and general conclusions of the standard ground modal testing of the PZL Sokol helicopter are presented. The preliminary results of the displacement and strain modal testing of a prototype helicopter separate tail boom are described. This testing was performed with aim to investigate the standard modal analysis approach enhancing with strain modal testing and selection of the response-only measurement data identification method. Some technical problems encountered during experimental work are addressed. The results of application of the theoretical structural dynamics behavior modelling with use of the FE technique as a supplement to the experimental techniques are considered. Finally, the inflight modal testing procedure which is about to start is characterized.
Author (AIAA)
Modal Response; Tail Assemblies; Booms (Equipment); Helicopter Design; Dynamic Structural Analysis; Flight Tests

19980062811

The Mi-34S - A world-class light helicopter ***Mi-34S - Legkij vertolet mirovogo urovnya***

Vyrelkin, Vladimir, OAO PO 'Legkie Vertolety Mi', Russia; Grazhdanskaya Aviatsiya; May 1997; ISSN 0017-3606, no. 5, pp. 23-25; In Russian; Copyright; Avail: Aeroplus Dispatch

The technical and performance characteristics of the the Mi-34S, a Russian light helicopter, are summarized. The Mi-34 S has a maximum speed of 215 km/hr and a maximum range of 420 km; it carries a payload of 360 kg; the fuel tank capacity is 180 l. Some of the possible applications of the helicopter include environmental monitoring, highway patrol, monitoring of transmission lines, railroads, and pipelines, passenger and light cargo transport, and training.
AIAA
Helicopter Performance; Light Aircraft; Environmental Monitoring; Airspeed; Fuel Tanks

19980065401

Thrust SSC: Britain challenges the world Part 2

Webb, Alan; Engineering Management Journal; Oct, 1997; ISSN 0960-7919; Volume 7, no. 5, pp. 237-244; In English; Copyright; Avail: Issuing Activity

The thrust SSC project, a car development project, can be divided into three basic problems, each of which demands a different solution: technical aspect, financial and resources, and organization aspects. This paper examines the organization and financial aspects of this remarkable project and shows that the approach taken is as radical as the car itself.
EI
UK; Project Management; Automobiles; Finance; Technologies; Supersonics

19980065487
Application of bifurcation methods to nonlinear flight dynamics problems
Goman, M. G., Central Aerohydrodynamic Inst. (TsAGI), Russia; Zagainov, G. I.; Khramtsovsky, A. V.; Progress in Aerospace Sciences; Sep-Oct, 1997; ISSN 0376-0421; Volume 33, no. 9-10, pp. 539-586; In English; Copyright; Avail: Issuing Activity

Applications of global stability and bifurcational analysis methods are presented for different nonlinear flight dynamics problems, such as roll-coupling, stall, spin, etc. Based on the results for different real aircraft, F-4, F-14, F-15, High Incidence Research Model, (HIRM), the general methods developed by many authors are presented. The outline of basic concepts and methods from dynamical system theory are also introduced.
Author (EI)
Systems Analysis; Branching (Mathematics); Convergence; Numerical Analysis; Mathematical Models

19980065493
Reduction of helicopter blade-vortex interaction noise by active rotor control technology
Yu, Yung H., AVRDEC, USA; Gmelin, Bernd; Splettstoesser, Wolf; Philippe, Jean J.; Prieur, Jean; Brooks, Thomas F.; Progress in Aerospace Sciences; Sep-Oct, 1997; ISSN 0376-0421; Volume 33, no. 9-10, pp. 647-687; In English; Copyright; Avail: Issuing Activity

Helicopter blade-vortex interaction noise is one of the most severe noise sources and is very important both in community annoyance and military detection. Research over the decades has substantially improved basic physical understanding of the mechanisms generating rotor blade-vortex interaction noise and also of controlling techniques, particularly using active rotor control technology. This paper reviews active rotor control techniques currently available for rotor blade-vortex interaction noise reduction, including higher harmonic pitch control, individual blade control, and on-blade control technologies. Basic physical mechanisms of each active control technique are reviewed in terms of noise reduction mechanism and controlling aerodynamic or structural parameters of a blade. Active rotor control techniques using smart structures/materials are discussed, including distributed smart actuators to induce local torsional or flapping deformations.
Author (EI)
Active Control; Aircraft Noise; Blade-Vortex Interaction; Harmonic Control; Noise Reduction; Rotary Wings; Turbomachine Blades; Technologies

19980067063
Dynamics equations of an aircraft rotor-fuselage for flexible mutibody dynamics
Tang, Huaping, Nanjing Univ. of Aeronautics and Astronautics, China; Zhu, Demao, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1005-2615; Volume 29, no. 4, pp. 391-396; In Chinese; Copyright; Avail: Aeroplus Dispatch

The equations of rotor blade systems are derived on the basis of the analyses of lead-lag flap and torsion motion of rotor blades and multibody system theory. The equations of fuselage are derived by use of superelement technology, and the equations of the coupled rotor-fuselage system are derived by means of the mode superelement. The equations of the couple rotor-fuselage are linearized. An illustrative example is given.
Author (AIAA)
Rotor Blades; Fuselages; Rotary Wings

19980067156
Multidisciplinary optimisation of a supersonic transport using design of experiments theory and response surface modelling
Giunta, A. A., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Balabanov, V., Virginia Polytechnic Inst. and State Univ., Blacksburg; Haim, D., Virginia Polytechnic Inst. and State Univ., Blacksburg; Grossman, B., Virginia Polytechnic Inst. and State Univ., Blacksburg; Mason, W. H., Virginia Polytechnic Inst. and State Univ., Blacksburg; Watson, L. T., Virginia Polytechnic Inst. and State Univ., Blacksburg; Haftka, R. T., Florida, Univ., Gainesville; Aeronautical Journal; Oct. 1997; ISSN 0001-9240; Volume 101,, no. 1008, pp. 347-356; In English

Contract(s)/Grant(s): NAG-1-1562; Copyright; Avail: Aeroplus Dispatch

The presence of numerical noise in engineering design optimization problems inhibits the use of many gradient-based optimization methods. This numerical noise may result in the inaccurate calculation of gradients which in turn slows or prevents convergence during optimization, or it may promote convergence to spurious local optima. The problems created by numerical noise are particularly acute in aircraft design applications where a single aerodynamic or structural analysis of a realistic aircraft configuration may require tens of CPU hours on a supercomputer. The computational expense of the analyses coupled with the convergence difficulties created by numerical noise are significant obstacles to performing aircraft multidisciplinary design optimization. to address these issues, a procedure has been developed to create noise-free algebraic models of subsonic and supersonic aerodynamic performance quantities for use in the optimization of high-speed civil transport (HSCT) aircraft configurations. This procedure employs methods from statistical design of experiments theory and response surface modeling to create the noise-free algebraic models. Results from a sample HSCT design problem involving 10 variables are presented to demonstrate the utility of this method.

Author (AIAA)

Multidisciplinary Design Optimization; Supersonic Transports; Experiment Design; Mathematical Models; Aircraft Design

19980067159

Efficient and robust algorithms for trim and stability analysis of advanced rotorcraft simulations

McVicar, J. S. G., Glasgow Caledonian Univ., UK; Bradley, R., Glasgow Caledonian Univ., UK; Aeronautical Journal; Oct. 1997; ISSN 0001-9240; Volume 101,, no. 1008, pp. 375-387; In English; Copyright; Avail: Aeroplus Dispatch

This paper derives innovative techniques for use in the trimming and stability analysis of advanced rotorcraft simulations. It exploits the symmetry of the rotor to produce an efficient definition of periodic trim which is applicable to rotorcraft simulations. This definition is then expanded to produce a trimming algorithm which is capable of concurrently ascertaining the initial conditions and control inputs necessary to trim latest generation simulation models to a specified periodic trim state. The algorithm is based on a periodic shooting approach with Newton-Raphson iteration and exploits the symmetry of the rotor to minimize computational workload. The definition of periodic trim is then further developed to produce a technique by which the stability characteristics of rotorcraft can be ascertained from advanced simulation models. This technique is based on a Floquet approach and again exploits the symmetry of the rotor to reduce computational burden. The paper concludes by presenting results obtained when the stability characteristics of a tiltrotor simulation model are investigated.

Author (AIAA)

Robustness (Mathematics); Algorithms; Aircraft Stability; Aerodynamic Balance; Aircraft Models; Helicopter Control; Simulation

19980067489

Straight up into the blue

Mark, Hans, Texas, Univ., Austin, USA; Scientific American; Oct. 1997; ISSN 0036-8733; Volume 27, no. 4, pp. 110-115; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation is presented of the technological development status, operational advantages and commercial prospects of tiltrotor VTOL aircraft, which are about to be given their military debut in the form of the V-22 Osprey for airborne troop deployment and logistical support. Tiltrotors are noteworthy for their combination of helicopter-like hover with turboprop-like forward flight. The commercial version being proposed for civilian operations is much smaller than the V-22, and would be flown primarily from urban areas with heliports.

AIAA

Tilt Rotor Aircraft; Aerospace Technology Transfer; Military Aircraft; Commercial Aircraft

19980067490

The lure of Icarus

Carlson, Shawn, San Diego State Univ., USA; Scientific American; Oct. 1997; ISSN 0036-8733; Volume 27, no. 4, pp. 116-119; In English; Copyright; Avail: Aeroplus Dispatch

A survey is presented of current design practices and developmental initiatives in human-powered flight (HPF), which was initially stimulated by the Kremer Prize challenges to higher performance in the 1970s. The Gossamer Albatross and Gossamer Condor, and the current endurance record-holding Icarus, are successful HPF aircraft that embody the ultralight structural tech-

niques and extreme wingspan of all such designs. The next-generation Raven aircraft will attempt a continuous HPF of 160 km, or about 5 hrs of airborne time.
AIAA
Man Powered Aircraft; Research and Development

19980067556

Neural network-based failure rate for Boeing-737 tires

Al-Garni, Ahmed Z., King Fahd Univ. of Petroleum and Minerals, Saudi Arabia; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 771-777; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents an artificial neural network (ANN) model for forecasting the failure rate of Boeing 737 airplane tires. A neural model is developed using the backpropagation algorithm as a learning rule. The inputs to the neural network are independent variables, and the output is the failure rate of the tire. A comparison of the neural model with the Weibull model is made for validation purposes. It is found that the failure rate predicted by the ANN is closer in agreement with the real data than the failure rate predicted by the Weibull model.
Author (AIAA)
Boeing 737 Aircraft; Aircraft Tires; Failure Modes; Neural Nets; Weibull Density Functions

19980067561

Novel nacelle thermal anti-icing exhaust grill for enhanced mixing

Gillan, Mark A., Belfast, Queen's Univ., UK; Farren, Roy, Short Brothers plc, UK; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 811-813; In English; Copyright; Avail: Aeroplus Dispatch

Results of a Navier-Stokes investigation performed to enhance the mixing characteristics of an in-service thermal anti-icing (TAI) exhaust grill are presented. Code corrlation with flight-test data for the current TAI exhaust grill design, during the maximum power climb phase of the flight regime, is excellent. A novel mixing-lobe TAI exhaust grill, with a blended central tapered bar, is shown to exhibit superior mixing characteristics. However, to reduce the maximum fan cowl door temperature to its 130 C tolerance limit, thus preventing paint blistering, a 3/4-in.-high faired fence is required in conjunction with the mixing lobe TAI exhaust grill design.
AIAA
Nacelles; Aircraft Icing; Exhaust Gases; Deicing; Temperature Distribution

19980067562

Field measurements of helicopter rotor wash in hover and forward flight

Teske, Milton E., Continuum Dynamics, Inc., USA; Kaufman, Andrew E., Continuum Dynamics, Inc., USA; George, Charles W., USDA, Forest Service, USA; Johnson, Gregg M., USDA, Forest Service, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 813, 814; In English; Copyright; Avail: Aeroplus Dispatch

Field measurements of helicopter rotor wash in hover and forward flight conducted from July 26 to July 29 and from September 27 to October 1, 1994, are reported. Propeller anemometers measured the induced downwash and sidewash velocities generated by the helicopters in hover or forward flight above the tower grid, in a fashion similar to the technique used to collect data to infer the decay behavior of aircraft vortices near the ground. Resulting time histories from the anemometers are examined to recover the magnitude and behavior of the induced velocities. The complete data set, including descriptive data about the helicopters, is summarized. The results may be used to infer the potential for any helicopter to promote the sideways spread of fire, pesticides, dust, aerosols, or other contaminants.
AIAA
Helicopter Design; Rotary Wings; Velocity Measurement

19980067610

AFTI/F-16 readied for JSF tests

Phillips, Edward H., USA; Aviation Week & Space Technology; Nov. 24, 1997; ISSN 0005-2175; Volume 147, no. 21, pp. 67; In English; Copyright; Avail: Aeroplus Dispatch

The Advanced Fighter Technology Integration F-16 will be fitted with electrically operated flight control actuators and a modular electrical power system as part of the Integrated Subsystem Technology demonstration for the U.S.'s multiservice Joint

Strike Fighter program. The tests to be conducted by this aircraft will allow Lockheed Martin to validate computer models of the systems, and scale those models up or down as required.
AIAA
F-16 Aircraft; Flight Control; Actuators

19980067765

Fly-by-light aircraft system cable plants

Weaver, Thomas L., McDonnell Douglas Aerospace, USA; 1997, pp. 7.3-1 to 7.3-8; In English; Copyright; Avail: Aeroplus Dispatch

A program was completed with joint industry and government funding to apply fiber optics to aircraft. The technology offers many potential benefits, such as increased EM interference immunity and the possibility of reduced weight, increased reliability, and enlarged capability by redesigning architectures to use the bandwidth of fiber optics. Those benefits can be realized if fiber optics meets the requirements of aircraft networks. The Fly-by-Light Advanced System Hardware (FLASH) program expanded on previous cable plant efforts by building components based on a cohesive aircraft cable plant system concept. The concept was rooted in not just optical performance, but also cost, manufacturing, installation, maintenance, and support. to do that, the FLASH team evaluated requirements, delineated use conditions, and designed, built, and tested fiber optic components for transport aircraft, tactical aircraft, and helicopters. In addition, the FLASH team developed installation and test methods, and support equipment for aircraft optical cable plants. The results of the effort are reported here.
Author (AIAA)
Fly by Light Control; Fiber Optics; Aircraft Equipment; Cables

19980067766

Fiber optic experience with the smart actuation system on the F-18 systems research aircraft

Zavala, Eddie, NASA, USA; 1997, pp. 7.3-9 to 7.3-25; In English; Copyright; Avail: Aeroplus Dispatch

High bandwidth, immunity to EM interference, and potential weight savings have led to the development of fiber optic technology for future aerospace vehicle systems. This technology has been incorporated in a new smart actuator as the primary communication interface. The use of fiber optics simplified system integration has significantly reduced wire count. Flight test results showed that fiber optics could be used in aircraft systems and identified critical areas of development of fly-by-light technology. This paper documents the fiber optic experience gained as a result of this program, and identifies general design considerations that could be used in a variety of specific applications of fiber optic technology. Environmental sensitivities of fiber optic system components that significantly contribute to optical power variation are discussed. Although a calibration procedure successfully minimized the effect of fiber optic sensitivities, more standardized calibration methods are needed to ensure system operation and reliability in future aerospace vehicle systems.
Author (AIAA)
Fiber Optics; F-18 Aircraft; Research Aircraft; Actuators; Smart Structures

19980067892

Have Blue and the F-117A: Evolution of the ’Stealth Fighter’

Aronstein, David C., ANSER, USA; Piccirillo, Albert C., ANSER, USA; 1997; In English; ISBN 1-56347-245-7; Copyright; Avail: Aeroplus Dispatch

A development history and design features evaluation is presented for ’low observables’ aircraft and the F-117A that is the culmination of radar-absorption and IR emission-suppression practices investigated for previous aircraft. Attention is given to the management of the ’Have Blue’ technology-integration/demonstration program by Lockheed according to ’Skunk Works’ principles. The fundamental principles of electromagnetic camouflage are also presented.
AIAA
F-117A Aircraft; Aircraft Design; Evolution (Development)

19980068285

Flying laboratories ***Die fliegende Labors***

DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 20-23; In German; Copyright; Avail: Aeroplus Dispatch

The use of a variety of flying laboratories to test aircraft parts is addressed. The ’flying simulator’ VFW 614 ATTAS (Advanced Technologies Testing Aircraft), the flying helicopter simulator ACT/FHS, the DO 228-2101 simulator for testing avionics, and the BO 105 helicopter are discussed.
AIAA
Flying Platforms; Flight Simulators; BO-105 Helicopter; Avionics

19980068289
Materials and structures of the future ***Werkstoffe und Strukturen der Zukunft***
DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 42-47; In German; Copyright; Avail: Aeroplus Dispatch
Research into the development of fiber composites for use in future transportation vehicles being carried out at the Institute for Structural Mechanics in Germany is discussed. Attention is given to the study of adaptive structures, thermostable structures, damage-tolerant structures, and structures for space transportation.
AIAA
Fiber Composites; Spacecraft Construction Materials; Structural Stability; Structural Analysis; Thermal Stability

19980068632
Shimmy analysis of a simple aircraft nose landing gear model using different mathematical methods
Somieski, Gerhard, DLR, Germany; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 8, pp. 545-555; In English; Copyright; Avail: Aeroplus Dispatch
Shimmy oscillations are still a problem in design and operation of aircraft landing gears, and accurate and appropriate analysis is required to master the task. Based on a nonlinear model of the mechanics of the landing gear and tire elasticity according to elastic string theory, some well known linear and nonlinear mathematical methods are applied to the shimmy analysis of a simple model of a nose gear; these encompass computing eigenvalues, solving analytically the stability boundaries with a parameter space method, finding limit cycles by analytical formulae from describing functions, and numerical simulation of time histories. It seems that linear or quasi-linear methods and analytical solutions are well suited to obtain insights, respecting the limitations of these methods. Numerical simulation, on the other hand, is a valuable tool for pointing out specific effects of a nonlinear system in large amplitude regions.
Author (AIAA)
Landing Gear; Nose Wheels; Oscillations; Structural Vibration; Dynamic Structural Analysis; Aircraft Tires; Nonlinear Systems

19980068649
The Draper Laboratory small autonomous aerial vehicle
DeBitetto, Paul A., Charles Stark Draper Lab., Inc., USA; Johnson, Eric N., Charles Stark Draper Lab., Inc., USA; Bosse, Michael C., Boston Univ., USA; 1997, pp. 110-120; In English; Copyright; Avail: Aeroplus Dispatch
The Charles Stark Draper Laboratory and students from MIT and Boston U. have cooperated to develop an autonomous aerial vehicle that won the 1996 International Aerial Robotics Competition. This paper describes the approach, system architecture and subsystem designs for the entry. This entry represents a combination of many technology areas: navigation, guidance, control, vision processing, human factors, packaging, power, real-time software, and others. The aerial vehicle, an autonomous helicopter, performs navigation and control functions using multiple sensors: differential GPS, inertial measurement unit, sonar altimeter, and a flux compass. The aerial transmits video imagery to the ground. A ground-based vision processor converts the image data into target position and classification estimates. The system was designed, built, and flown in less than one year, and has provided many lessons about autonomous vehicle systems, several of which are discussed.
Author (AIAA)
Laboratory Equipment; Autonomous Navigation; Aircraft Design; Rotary Wing Aircraft

19980068683
The bionics experiments on aerodynamic shape of aircraft components
Zhou, Ruixing, Northwestern Polytechnical Univ., China; Shangguan, Yunxin, Northwestern Polytechnical Univ., China; Xi, Zhongxiang, Northwestern Polytechnical Univ., China; Yu, Xinzhi, Northwestern Polytechnical Univ., China; Xia, Yushun, Northwestern Polytechnical Univ., China; Wang, Zongdong, Northwestern Polytechnical Univ., China; Li, Jianying, Northwestern Polytechnical Univ., China; Xue, Yongli, Northwestern Polytechnical Univ., China; 1997, pp. 144-149; In English; Copyright; Avail: Aeroplus Dispatch
This paper presents the fluid-dynamical bionics construct characteristics and model testing methods for two main aircraft components, single body and single wing, from the viewpoint of adaptation to the environment. It is shown that an elliptical cone

imitating a shark's head can efficiently decrease the side force produced by a slender body at high angles of attack. Rough surfaces imitating shark skin reduce drag by 9 percent. These findings have wide applications in the study of aircraft fluid dynamic characteristics.
AIAA
Bionics; Aircraft Structures; Aerodynamic Configurations

19980068685
The numerical study of the propeller slipstream/whole aircraft interaction
E, Qin, Northwestern Polytechnical Univ., China; Yang, Guowei, Northwestern Polytechnical Univ., China; Li, Fengwei, Northwestern Polytechnical Univ., China; Fu, Dawei, Xian Aircraft Research Inst., China; 1997, pp. 158-165; In English; Copyright; Avail: Aeroplus Dispatch

Free wake analysis was used to calculate the flow field characteristics of an isolated propeller vortex wake and the propeller performance parameters. The panel method was used for the numerical calculations and the propeller vortex system rotating with its blades and the steady horseshoe vortex system distributed on the aircraft surface were used as the mathematical model. The Neumann boundary conditions were satisfied at the panel control points of the blade and the aircraft panel in order to achieve the coupling of the propeller slipstream with the whole flow field of the aircraft. At each corresponding azimuth angle of the propeller, the pressure coefficients and velocities induced by the two vortex systems at the panel control points were calculated and the average aerodynamic characteristics of the aircraft in one revolution period were obtained. The contraction effect of the 3D propeller slipstream and its influence on the flow field were considered in the computation. Results of the numerical examples showed that the slipstream had as significant an effect on the aircraft lifting characteristics as the flap deflection, resulting in relatively large changes of the aircraft moment performance. The numerical results were in good agreement with the experimental data. The method presented here is suitable for both single and multiple propeller aircraft.
AIAA
Slipstreams; Panel Method (Fluid Dynamics); Vortices; Propellers; Aircraft Structures

19980068725
The influence of tire characteristic parameters on aircraft wheel shimmy
Zhou, Jinxiong, Northwestern Polytechnical Univ., China; Zhu, Depei, Northwestern Polytechnical Univ., China; 1997, pp. 390-393; In English; Copyright; Avail: Aeroplus Dispatch

A systematic investigation of the influence of five tire characteristic parameters, i.e., lateral stiffness, torsional stiffness, cornering stiffness, lateral rolling coefficient, and torsional rolling coefficient, on aircraft wheel shimmy is presented. In order to study the influence of cornering stiffness on shimmy, a second-order model of tire cornering characteristics is set up. A comparison is made between the results of this second-order model and those of the first-order model which is in common use in the present shimmy literature. The comparison has revealed that the second-order model is more accurate and reliable. Finally, comments on the influence of tire characteristic parameters on shimmy are made.
Author (AIAA)
Aircraft Tires; Wheels; Mechanical Properties

19980068727
Knowledge based system for design of wing structure
Kuntjoro, Wahyu, Bandung, Indonesia; 1997, pp. 398-407; In English; Copyright; Avail: Aeroplus Dispatch

Airframe design is an iterative process involving synthesis and analysis. During an airframe design process, it is always necessary to make decisions with respect to aspects such as, shapes of structural components, material selection, design constraints, and element types to use if finite element modeling is performed. In general, a design process should consider functional and manufacturing aspects of designed products. This paper shows the development of an object-oriented knowledge base as a tool to support structural designers in making design decisions. A knowledge base scheme in this research is set up as a combination of object and rule (rule-based structure) concepts. The application of the object-oriented knowledge base to the design of wing structures is shown.
Author (AIAA)
Knowledge Bases (Artificial Intelligence); Wing Profiles; Structural Design

19980068728
Optimisation studies on composite wing structure
Saravanan, P. M., Aeronautical Development Establishment, India; Jacob, K. A., Aeronautical Development Establishment, In-

dia; Prabhakaran, V., Aeronautical Development Establishment, India; Rangaiah, V. P., Aeronautical Development Establishment, India; Mayuram, M. M., Indian Inst. of Technology, India; 1997, pp. 408-415; In English; Copyright; Avail: Aeroplus Dispatch

The optimum design of a composite wing has been achieved through an iterative design considering different structural concepts and material systems for the given design constraints, design specifications, and design objectives. Iterative design has been carried out in conjunction with FE analysis, enabling the evaluation of different structural design concepts and the use of state-of-the-art materials. Three performance criteria were used to demonstrate design adequacy: structural frequency range, safety margins for strength, and displacement. The utilization of materials with maximum efficiency is incorporated by defining the material utilization factor based on the summation of reserve factors over material volume. Limited structural tests were performed to validate FE results. The experimental results were found to be in good agreement with FE results. The wing has been fabricated as per the optimum design configuration and flight-tested on indigenous remotely piloted vehicles several times.

Author (AIAA)

Wing Profiles; Structural Design; Optimization; Stiffness; Tensile Stress; Resin Matrix Composites

19980068732

Analysis on field maintenance technology for a helicopter

Zhang, Xingbo, Air Force, First Aeronautical Inst., China; Li, Dugao, Air Force, First Aeronautical Inst., China; Xiong, Shuiying, Air Force, First Aeronautical Inst., China; 1997, pp. 434-437; In English; Copyright; Avail: Aeroplus Dispatch

Field maintenance of a helicopter is an effective method to bring its high maneuverability and flexibility into full play, enlarge its moving range, and improve its survivability. However, the implementation of the field maintenance is restricted by many factors such as environment, traffic, transportation, etc. This paper mainly expounds the necessity of implementing field maintenance and proposes two implementation programs according to the basic requirements of the basic Chinese environment and traffic conditions or field maintenance.

Author (AIAA)

Aircraft Maintenance; Helicopters; Maneuverability

19980068733

Experimental study of circulation control tailboom

Luo, Xiaoping, Air Force, First Aeronautical Inst., China; Zhang, Chenlin, Nanjing Univ. of Aeronautics and Astronautics, China; Shen, Mongshan, Nanjing Univ. of Aeronautics and Astronautics, China; 1997, pp. 438-443; In English; Copyright; Avail: Aeroplus Dispatch

A helicopter model with circulation control tailboom was designed and tested to measure the pressure distribution on a tailboom surface with the model in a tunnel and under the rotor, respectively. The aerodynamic forces on the tailboom were calculated, and their change with the circulation control variables is shown. The main purpose of the test was to study the effect of the momentum coefficient and the slot's geometric variables on the aerodynamic forces of the circulation control tailboom. The flow patterns on the tailboom were also tested. The circulation control and its application were studied in terms of the test results. Reasonable explanations are given of the test results, and some new conclusions are obtained.

Author (AIAA)

Booms (Equipment); Tail Rotors; Helicopters; Aircraft Models

19980068739

A tentative plan on new type ejection seat with canopy

Chen, Wanmei, Air Force, First Aeronautical Inst., China; Li, Yongzhong, Air Force, First Aeronautical Inst., China; 1997, pp. 470-474; In English; Copyright; Avail: Aeroplus Dispatch

During ejection, an ejection seat with canopy can give good protection for the pilot. However, it has the disadvantages of poor lifesaving ability at low altitude and low man-seat seperation velocity. In view of this situation, this paper proposes a tentative plan for a new kind of ejection seat with canopy which is suited for ejection at high velocity and at low altitude.

Author (AIAA)

Ejection Seats; Canopies; Aircraft Survivability

19980069439

Shape optimizing nacelle near flat-plate wing using multiblock sensitivity analysis

Eleshaky, Mohamed E., Old Dominion Univ., USA; Bayasal, Oktay, Old Dominion Univ., USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 33-38; In English

Contract(s)/Grant(s): NAG1-1188; Copyright; Avail: Aeroplus Dispatch

A methodology was demonstrated to optimize nacelle shapes with and without the presence of a flat plate nearby to account for the wing interference. Overly simplified shapes notwithstanding, this process requires multiblock grids not only for its aerodynamic analysis, but also for its optimization. Although the former is a standard practice, the latter has only recently been possible for the gradient-based optimizations with the development of the sensitivity analysis with domain decomposition scheme. The analyses were obtained by solving the 3-D, compressible, thin-layer Navier-Stokes equations using an implicit, upwind-biased, finite volume scheme. In addition to demonstrating the present method's suitability for automated shape optimization of interfering aircraft components, such as a nacelle and a wing, the results verified two important issues. First, accounting for the aerodynamic mutual interference between components in close proximity manifested itself in a shape different than that obtained when a component was assumed to be isolated. Secondly, even for isolated-component designs, neglecting the viscous effects compromised not only the flow physics but also the optimized shapes.
Author (AIAA)
Nacelles; Flat Plates; Wings; Drag Reduction; Aerodynamic Interference; Aircraft Design

19980069443
Unsteady aeroelastic optimization in the transonic regime
Kolonay, R. M., USAF, Research Lab., USA; Yang, Henry T. Y., California, Univ., Santa Barbara; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 60-68; In English; Copyright; Avail: Aeroplus Dispatch

A methodology for including transonic flutter requirements in the preliminary automated structural design environment is developed and tested. The problem of minimizing structural weight while satisfying behavioral constraints is stated in nonlinear mathematical programming form and is solved using a gradient-based optimizing technique. The structure is modeled by using finite elements, and the associated design variables consist of the structural properties: thicknesses of skins, spars, and ribs; cross-sectional areas of posts and spar and rib caps; and concentrated masses. The indicial response method is used to transform time-domain aerodynamic forces found by solving the transonic small disturbance (TSD) equations into the Laplace domain. The indicial responses are calculated about static aeroelastic equilibriums found using the TSD equations for the steady aerodynamics. Once in the Laplace domain, the unsteady aerodynamic forces are used to determine system dynamic stability by the p-method and in semianalytic equations for the flutter constraint sensitivities. Examples of the redesign methodology are given for the simultaneous consideration of constraints on transonic flutter, stresses, and displacements. Results found using nonlinear aerodynamics show that designs can differ considerably from those obtained using linear unsteady aerodynamics when in the transonic flight regime.
Author (AIAA)
Unsteady Aerodynamics; Methodology; Transonic Flutter; Structural Design; Aircraft Design

19980069452
Methodology for implementing fracture mechanics in global structural design of aircraft
Nees, Clifton D., USAF, Research Lab., USA; Canfield, Robert A., USAF, Office of Scientific Research, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 131-138; In English; Copyright; Avail: Aeroplus Dispatch

The analysis and design criteria of fracture mechanics are investigated for implementation with the automated structural optimization system (ASTROS) global optimization design tool. The main focus is the optimal design of aircraft wing panels by applying fracture mechanics design criteria within the global finite element model. This effort consists of four main phases: investigation of fracture mechanics analysis methods and design criteria, formulation of a computational technique consistent with global optimization rcquirements, integration of the technique into the ASTROS design tool, and demonstration of the results.
Author (AIAA)
Methodology; Fracture Mechanics; Structural Design; Aircraft Design; Aircraft Structures; Structural Design Criteria

19980069454
Nonstationary random parametric vibration in light aircraft landing gear
Huntington, D. E., San Diego State Univ., USA; Lyrintzis, C. S., San Diego State Univ., USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 145-151; In English; Copyright; Avail: Aeroplus Dispatch

A new approach for analysis of random vibration in light aircraft landing gear for a given duty cycle is developed and studied. The aircraft is modeled as a linear, single-degree-of-freedom oscillator with random properties, including nonstationary damping and random nonstationary load. This type of problem is difficult to analyze efficiently using most conventional techniques. Two approaches to analyze the random vibration of the system are examined: a new variant of the random matrix approach, a statistical random vibration analysis method developed previously by the authors; and a hybrid Monte Carlo technique containing a spectral

representation approach and a variant of Latin hypercube sampling. Random response results are shown for two light aircraft landing on three different terrain types using each method, and comparisons are offered. These results show that Monte Carlo analysis cannot compute accurate solutions for this problem. It is anticipated that the proposed random matrix technique could be used in conjunction with current fatigue analysis methods so that accurate landing gear fatigue information may be computed.
Author (AIAA)
Light Aircraft; Landing Gear; Structural Vibration; Random Vibration

19980069455

Static aeroelastic considerations for circulation control airfoils

Zeiler, Thomas A., Alabama, Univ., Tuscaloosa, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 152-154; In English; Copyright; Avail: Aeroplus Dispatch

Studies have been undertaken on the static aeroelastic effects of circulation control. The purpose of this article is to explore the similarity and difference between static aeroelastic effects of circulation-control airfoils and on conventional airfoils with trailing-edge controls. The similarity is used to define two parameters that highlight an important difference in load effectiveness between the two.
AIAA
Aeroelasticity; Circulation Control Airfoils; Static Aerodynamic Characteristics

19980069457

Sensitivity of aeroelastic efficiencies of subsonic delta wings to partial root support

Joshi, Ashok, Indian Inst. of Technology, India; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 155-157; In English; Copyright; Avail: Aeroplus Dispatch

Modern military aircraft employ wings with a delta shape, which provides good aerodynamic and aeroelastic performance. Delta wings are generally constructed using a single spar as the wing torsion box, with a width of about 60-85 percent of the total chord; thus there is only a partial connection of the wing root to the fuselage. Because the fuselage is much stiffer than the wing, it is possible to model the wing junction with the fuselage as a clamp for structural analysis of the wing. The location and size of the torsion box have a strong influence on the elastic deformation pattern of the wing and, therefore, have the potential to significantly alter the overall aerodynamic lift and pitching moment efficiencies from static aeroelastic corrections. Information about the sensitivity of these efficiencies to the size and location of the torsion box is considered very useful for making minor adjustments that enable desirable aerodynamic characteristics. This paper demonstrates the sensitivity of aeroelastic efficiencies of a generic equivalent plate delta wing for different values of the leading-edge sweep and root-clamp configuration, and for two values of the subsonic flight Mach number.
AIAA
Aeroelasticity; Delta Wings; Subsonic Aircraft; Wing Roots

19980069458

Role of modal interchange on the flutter of laminated composite wings

Georghiades, G. A., City Univ., UK; Banerjee, J. R., City Univ., UK; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 157-161; In English; Copyright; Avail: Aeroplus Dispatch

Investigators examining the flutter behavior of laminated composite wings have often observed some unexpected blips or abrupt changes occurring at certain fiber angles of the laminate. These observations were confirmed by the authors (Georghiades et al., Journal of Aircraft, vol. 33, no. 6, 1996), who concluded that the primary cause for these blips lies in the modal contributions at flutter, arising from ply orientations in the laminate. This paper reports on further investigations by looking into this unusual feature and pinpointing its underlying cause. For illustrative purposes, one of the example wings of the above reference that exhibited the aforementioned characteristics is further studied. First, a modal elimination technique is used to establish the number of dominant normal modes that contributed to the flutter behavior for different ply angles in the laminate. Next, the flutter mode is computed using selective normal modes that were found to be primarily responsible to cause flutter. Finally, contributions from each normal mode to the flutter mode are isolated in each case, and their relative individual contributions are studied. The results are discussed, and some conclusions are drawn.
AIAA
Flutter Analysis; Composite Structures; Vibration Mode; Modal Response; Wings

19980069515

Applications of vulnerability analysis and test methods to aircraft design

Griffis, Hugh, USAF, USA; 1997, pp. 65-71; In English; Copyright; Avail: Aeroplus Dispatch

Over a period of many years, the DOD has developed several ways to lower the number of aircraft lost in combat. This paper outlines a systems-engineering-based approach and a description of hardening concepts that can greatly reduce the vulnerability of aircraft to fires and explosions. The systems engineering design process includes modeling and testing, which can predict and demonstrate the capability of hardening design features. Known limitations in modeling and testing are highlighted.

Author (AIAA)

Aircraft Design; Aircraft Survivability; Fires; Explosions; Fire Prevention

19980069541

Taking safety into account in the Rafale program ***La prise en compte de la securite dans le programme Rafale***

Chambon, Eric, Dassault Aviation, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Sep. 1997; ISSN 1247-5793, no. 4, pp. 12-17; In French; Copyright; Avail: Aeroplus Dispatch

For the first time in the Rafale program, global safety requirements have been defined for the whole aircraft instead of specific system safety requirements on previous programs. This article explains how, from the early stages of development in April 1988, the basic safety rules have been firmly expressed and how they have been implemented until now.

AIAA

Military Aircraft; Flight Safety; Aircraft Safety

19980069744 Bureau of Aeronautics (Navy), Washington, DC USA

Operation REDWING: Project 5.8. Evaluation of the A3D-1 Aircraft for Special Weapons Delivery Capability

1998; 154p; In English; Portions of this document are not fully legible

Report No.(s): PB98-134075; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The report presents the results of the participation of the A3D airplane in Project 5.8 of Operation Redwing. Primary objective of this project was to determine the response of the structure of the A3D-1 aircraft to the thermal effects of a thermonuclear explosion, primarily for the purpose of establishing critical thermal envelopes for the aircraft when utilized for the delivery of large yield devices.

NTIS

Thermonuclear Explosions; A-3 Aircraft; Temperature Effects; Weapons Delivery

19980069924

777 wing and engine ice protection system

McMurtry, Paul H., Hamilton Standard, USA; Jul. 1997; In English

Report No.(s): SAE Paper 972260; Copyright; Avail: Aeroplus Dispatch

This paper describes the wing and engine ice protection system used on all 777 aircraft. The 777 ice protection system is unique in two ways: it has an advanced control system which minimizes aircraft power consumption. In addition, the system was procured by the prime contractor, Boeing, as a fully integrated subsystem from a single supplier.

Author (AIAA)

Boeing 777 Aircraft; Wings; Ice Prevention; Control Systems Design; Automatic Test Equipment

19980070242

Commercial development of D357 alloy investment cast aircraft door substructures

Kennerknecht, S. F., CERCAST, Canada; Witgens, G., CERCAST, Canada; Tombari, R., CERCAST, Canada; Van Biljon, P., CERCON, USA; Dumant, X., CIRAL, France; 1997, pp. 61-80; In English; Copyright; Avail: Aeroplus Dispatch

Net shape investment castings are being specified for a significant number of modern airframe structures. Dramatic cost reductions have been realized without weight increase or impact on safety margins when replacing traditional machined from solid (hogouts) or fabricated sheet metal components (assemblies) with high-integrity D357 alloy investment castings. Aircraft structures have designs based upon either safe-life or damage-tolerant criteria, specifying critical material requirements for either ultimate load, yield strength, fatigue, fracture toughness, or crack propagation. The design of efficient castings capitalizes upon the predictable and uniform isotropic properties of these monolithic structures, without the allowance for fastener flexibility or joint

failure. Most aircraft structures are joint critical, and castings have been identified as a cost effective method of significantly reducing the number of subassemblies and joints.
Author (AIAA)
Aluminum Alloys; Investment Casting; Aircraft Structures; Doors; Safety Factors

19980070344

Recent developments in smart structures with aeronautical applications

Loewy, Robert G., Georgia Inst. of Technology, Atlanta, USA; Smart Materials and Structures; Oct. 1997; ISSN 0964-1726; Volume 6,, no. 5, pp. R11-R42; In English; Copyright; Avail: Aeroplus Dispatch

The results of a representative sampling of recent papers dealing with smart materials and structures as actuators in aeronautical systems are summarized here. Their potential for improving performance, handling qualities in a stall, and increasing fatigue life is discussed briefly as requiring relatively slow-acting shape and shape-distribution changes. A similar review is made of applications for improving aeroelastic divergence, flutter instabilities, and tail buffeting on fixed-wing aircraft; and reducing vibrations, improving external acoustics, and providing flight controls for rotating-wing aircraft - all of which require a high-frequency response. The status of some of the most promising developments is noted and the remaining problems are touched on. Two approaches, which have not been given substantial attention elsewhere, are reviewed: developing concentrated, namely non-distributed, piezoelectric actuators in helicoidal configurations, on the one hand, as a way to improve force-deflection output; and using control surfaces purposefully designed to be marginally unstable and stabilized by smart structures, on the other hand, as a means of reducing the force-deflection combinations required of smart-structure actuators.
Author (AIAA)
Smart Structures; Smart Materials; Actuators; Aeronautical Engineering

19980070810

B-2 aircrew seat comfort cushion design and development

Severance, Claude M., Northrop Grumman Corp., USA; 1997, pp. 25-32; In English; Copyright; Avail: Aeroplus Dispatch

Northrop has designed and developed a new cushion for its B-2 ACES II seats. The development included flight test evaluations of various cushion design prototypes. These tests led to the selection of the best cushion and its eventual incorporation into production aircraft. Actual use of the new cushion on very long duration missions has confirmed the improvement in aircrew comfort over the original ACES II cushion design.
Author (AIAA)
B-2 Aircraft; Seats; Cushions; Product Development

19980070832

The application of inflatable aerodynamic stabilizers on an ejection seat

Neal, M. F., Martin-Baker Aircraft Co., Ltd., UK; Lingard, J. S., Martin-Baker Aircraft Co., Ltd., UK; 1997, pp. 268-277; In English; Copyright; Avail: Aeroplus Dispatch

Inflatable aerodynamic stabilizers offer potential improvements in ejection seat performance for current and future seats. We detail the results of system studies performed by Martin-Baker Aircraft to assess the efficacy of such devices and the feasibility of integrating such a system on an ejection seat. The inflatable stabilizers' potential mounting locations were evaluated, and initial stabilizer length and diameter were assessed. The static aerodynamics of the stabilizers were first calculated in isolation in order to quantify their magnitude and provide input for the Martin-Baker 6 degree-of-freedom (DOF) ejection seat simulation. Next, the stabilizer aerodynamics were superimposed on the static aerodynamics of the seat to predict the stable angle of flight of a seat fitted with stabilizers and to enable the design to be modified to give any desired stable angle. The stabilizer aerodynamics were used in the 6 DOF model to examine the effect of the stabilizers on actual test cases. The optimum configuration was then derived from these results. CFD analysis of the chosen configuration confirmed the results. Finally, the validated aerodynamic data was used to predict the performance of the seat with and without stabilizers in a number of configurations.
Author (AIAA)
Ejection Seats; Aerodynamic Stability; Inflatable Structures; Flight Crews; Static Aerodynamic Characteristics; Degrees of Freedom

19980070837

Development of an advanced energy absorber

Richards, Marvin K., Simula Technologies, Inc., USA; Podob, Roger, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 321-327; In English; Copyright; Avail: Aeroplus Dispatch

The attenuation of vertical impact forces in helicopter mishaps is one of the prime factors in determining survivability. Within the cockpit, energy-absorbing crewseats have made very significant improvements in helicopter crash survival. Energy absorbers (EAs; also known as energy attenuators or load limiters) were developed with a provision for manually adjusting the load so that a wide range of occupants would have equal protection in a crash. An EA load is selected that is proportional to the occupant's weight so that each occupant will experience similar acceleration and use similar stroking space in a crash. Work is currently underway to produce the next-generation energy absorber. The improved EA must be able to perform several functions. It must exhibit a load-deflection curve that produces the most efficient operation within the limits of human tolerance and within the limited vertical space available in military helicopters. It must also provide equal protection for the entire aircrew population, from the smallest female to the largest male, and it must adjust to the occupant's body weight automatically (without pilot input). The efforts to date have produced very promising results. This paper summarizes the development of the advanced energy absorber stroking profile and the seat dynamic test results.
Author (AIAA)
Cockpits; Impact Loads; Energy Absorption; Aerodynamic Forces; Aircraft Survivability; Seats

19980071416

SPECTRA - Protection and avoidance system for the Rafale fighter aircraft fire control ***SPECTRA - Systeme de Protection et d'Evitement des Conduites de Tir de l'avion de combat Rafale***

Chaltiel, Pierre-Yves, Dassault Electronique, France; Trouche, Jean-Marie, Thomson-CSF, France; Bernard-Guelle, Christian, Matra Defense, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Feb. 1997; ISSN 1247-5793, no. 1, pp. 23-33; In French; Copyright; Avail: Aeroplus Dispatch

The Rafale, a multipurpose combat aircraft designed for the Air Force and Naval Aviation, is protected by an integrated countermeasures system. This system, known as SPECTRA (a French acronym for Systeme de Protection et d'Evitement des Conduites de Tir du RAfale), contributes to the overall survivability of the aircraft throughout its various defense and attack missions, using the most sophisticated detection, jamming, and decoying techniques. Fully integrated to the aircraft airframe and its weapons system, this system decisively contributes to the discrete generation of a tactical situation for the pilot, who can thus see without being seen when executing his mission. The system is the Rafale's prime self-protection component against hostile forces. User-programmable, the system meets the versatility requirement for this new multi-role combat aircraft, and is capable of adapting to threats in years to come.
Author (AIAA)
Fighter Aircraft; Aircraft Survivability; Aircraft Design; Weapon Systems

19980071648

Large excrescences on transport aircraft - A cautionary tale

Greenwell, D. I., Defence Evaluation and Research Agency, UK; Aeronautical Journal; Sep. 1997; ISSN 0001-9240; Volume 101,, no. 1007, pp. 327-330; In English; Copyright; Avail: Aeroplus Dispatch

In recent years the increasing importance of electronic warfare has resulted in a proliferation of assorted antennae, large fairings and other foreign bodies attached to transport aircraft airframes. This note describes an installation which was extensively tested in a large-scale commercial windtunnel and was found to give apparently well-behaved steady-state aerodynamic characteristics but which, when flight tested, exhibited unacceptable levels of airframe buffeting and rather unusual directional stability problems. A re-examination of the fuselage flow field using a simplified model, but with attention focused on the unsteady aspects of the flow, rapidly identified the underlying cause and enabled a successful aerodynamic fix to be developed. The lessons learned from this experience are presented as a warning to those contemplating the addition of large excrescences to any airframe.
Author (AIAA)
Transport Aircraft; Aircraft Design; Electronic Warfare; Aircraft Antennas; Airframes

19980071907

Wind tunnel test of a smart rotor model with individual blade twist control

Chen, Peter C., Systems Planning and Analysis, Inc., USA; Chopra, Inderjit, Maryland, Univ., College Park; Journal of Intelligent Material Systems and Structures; May 1997; ISSN 1045-389X; Volume 8,, no. 5, pp. 414-425; In English
Contract(s)/Grant(s): DAAL03-92-G-0121; Copyright; Avail: Aeroplus Dispatch

We develop a smart rotor with active control of blade twist using embedded piezoceramic elements as sensors and actuators to minimize rotor vibrations. A 1/8 Froude-scale (dynamically scaled) bearingless helicopter rotor model was built with banks of torsional actuators capable of manipulating blade twist at frequencies from 5 to 100 Hz. to assess the effectiveness of the torsional actuators and vibration suppression capabilities, systematic wind tunnel testing was conducted. Using accelerometers

embedded in the blade tip, the oscillatory blade twist response was measured. The changes in rotor vibratory loads due to piezoinduced twist were determined using a rotating hub balance located at the rotor hub. Experimental test results show that tip twist amplitudes on the order of 0.5 deg are attainable by the current actuator configurations in forward flight. Although these amplitudes were less than the target value (1 to 2 deg for complete vibration suppression control), test results show that partial vibration reduction is possible. Using open-loop phase shift control of blade twist at the first four rotor harmonics, changes in rotor thrust of up to 9 percent of the steady-state values were measured.
Author (AIAA)
Smart Structures; Rotary Wings; Wind Tunnel Tests; Structural Strain; Active Control

19980072290

EH101 - Airfield performance testing of a three-engine helicopter

Swales, Michael R., Westland Helicopters, Ltd., UK; Cockpit; Jun. 1997; ISSN 0742-1508, pp. 5-26; In English; Copyright; Avail: Aeroplus Dispatch

In November 1994, the EH101 was the first helicopter to achieve simultaneously a preliminary Type Certification from three airworthiness agencies, the UK CAA, the FAA, and the Italian RAI. In continuation of the full certification process, an airfield performance trial was conducted at the EH101 production facility of Vergiate, near Milan, Italy, during summer 1996. Fifty-five hours were flown evaluating the handling and performance of the helicopter in Category A take-off and landing profiles and in ground level heliport operations. This paper discusses these tests, emphasizing the idiosyncrasies of the three engine configuration and the choice of techniques flown. Results are presented which match a mathematical model from a Helicopter Airfield Performance Simulation (HAPS) program to actual performance achieved. Once a satisfactory correlation is obtained, then HAPS will be used to generate the Flight Manual dynamic performance charts.
Author (AIAA)
Eh-101 Helicopter; Aircraft Reliability; Performance Tests; Helicopter Performance; Controllability; Flight Simulation

19980072467

Analysis and test of coupled dynamic stability of a helicopter twin-bladed rotor/rotor shaft system

Wang, Jidong, Beijing Univ. of Aeronautics and Astronautics, China; Zhang, Xiaogu, Beijing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Oct. 1997; ISSN 1005-2615; Volume 29, no. 5, pp. 488-493; In Chinese; Copyright; Avail: Aeroplus Dispatch

The coupled vibration of blade lead-lag motion and rotor shaft bending of a twin-bladed rotor helicopter is investigated. An analytical model is established. The modal frequency and modal damping of the three modes of this coupled system are analyzed, especially the mode existing in the unstable rpm region. The influence of blade mass, lead-lag stiffness and shaft bending stiffness on the instability is also investigated. This rotor system has been tested on a test rig. The dynamical stresses have been measured and the resonance frequencies have been found. by changing blade mass, lead-lag stiffness and shaft bending stiffness, the start rpm of the unstable region is increased by more than 90 rpm. The test data have verified the analysis and calculation. According to the results of the test and analysis, a comprehensive method to avoid the maximum design rpm falling into the unstable region is suggested.
Author (AIAA)
Rotary Wings; Helicopter Performance; Dynamic Stability; Structural Vibration

19980072651

An equivalent-point calibration method for dynamic load identifications

Gu, Huizhi, Nanjing Univ. of Aeronautics, China; Ding, Xihong, Nanjing Univ. of Aeronautics, China; Nie, Junjian, Aircraft Airworthiness Center, China; Journal of Vibration Engineering; Sep. 1997; ISSN 1004-4523; Volume 10, no. 3, pp. 329-334; In Chinese; Copyright; Avail: Aeroplus Dispatch

Aimed at the subject of identifying the buffeting loads acting on tail planes in flight, we propose a calibration method to identify the dynamic loads at unknown positions, called the equivalent-point calibration method. In the method, the response of a structure due to external dynamic loads whose positions are unknown is considered as the result of several pseudoconcentrated loads at several preselected points (equivalent points) on the structure. Thus the identification of dynamic load with unknown positions is reduced to identifying the loads at preselected points. According to the principle of equivalence, the magnitude and position of the external load can be indirectly identified in terms of pseudoloads.
Author (AIAA)
Calibrating; Dynamic Loads; Aerodynamic Loads

19980072666

Design and test of semicircular composite frames optimized for crashworthiness

Perez, Jose G., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Johnson, Eric R., Virginia Polytechnic Inst. and State Univ., Blacksburg; Boitnott, Richard L., U.S. Army, Research Lab., USA; 1998, pp. 27-38; In English

Contract(s)/Grant(s): NAG1-343; NAG1-537

Report No.(s): AIAA Paper 98-1703; Copyright; Avail: AIAA Dispatch

Vertical drop testing of transport aircraft fuselage sections indicate that the frames play a major role in the process of absorbing the impact energy in the crushing of the substructure below the main passenger deck. Subsequent static crush tests of scaled frames fabricated from graphite-epoxy tape show that they absorb less energy than Al counterparts due to the brittle-type failure modes of the composite, compared to failure by ductile yielding of the Al. A mathematical model developed to optimize open section curved composite frames under static crush loading for improved energy absorption is used to design previously fabricated graphite-epoxy frames not optimized for energy absorption. Flanges were resized on three of these previously fabricated semicircular, I-section frames. Static test results of the redesigned frames are compared to tests results of the nominally equivalent original frames. The tests results from the redesigned frames show an improved energy absorption relative to their original counterparts; the mathematical model predicts the correct sequence and location of failure events, but did not predict the magnitudes of the force and displacement at the first major failure event that occurred in the test.

Author (AIAA)

Crashworthiness; Drop Tests; Transport Aircraft; Fuselages; Airframes; Graphite-Epoxy Composites

19980072668

High speed bird impact analysis of the Learjet 45 windshield using DYNA3D

Boroughs, Robert R., Bombardier-Learjet, USA; 1998, pp. 49-59; In English

Report No.(s): AIAA Paper 98-1705; Copyright; Avail: AIAA Dispatch

The Learjet 45 windshield was analyzed for the high speed 330-kt bird impact condition at selected sites on the windshield surface. This windshield was fabricated from laminated polycarbonate material and mounted on a new windshield frame. The analysis was performed using the nonlinear explicit finite element program DYNA3D and the postprocessor TAURUS. The windshield and the adjacent support structure were modeled using a more detailed finite element model than was used in previous Learjet bird impact analyses. This approach was used so that a detailed definition could be obtained of the stresses in the windshield and the adjacent support structure. The data from this analysis were more comprehensive than in past windshield bird impact programs, and the results were used to provide guidance in the design, development and testing of the new windshield installation.

Author (AIAA)

Bird-Aircraft Collisions; Windshields; Lear Jet Aircraft; Polycarbonates; Laminates

19980072671

Response of composite fuselage sandwich side panels subjected to internal pressure and axial tension

Rouse, Marshall, NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Dopker, Bernard, Boeing Commercial Airplane Group, USA; Shah, Bharat, Lockheed Martin Aeronautical Systems, USA; 1998, pp. 87-98; In English

Report No.(s): AIAA Paper 98-1708; Copyright; Avail: AIAA Dispatch

The results from an experimental and analytical study of two composite sandwich fuselage side panels for a transport aircraft are presented. Each panel has two window cutouts and three frames, but uses a distinctly different structural concept. The panels were evaluated for internal pressure loads generating biaxial tension-loading conditions. Design limit load and design ultimate load tests are performed on both panels. One of the sandwich panels was tested with the middle frame removed to demonstrate the suitability of this two-frame design for supporting the prescribed biaxial loading conditions with twice the initial frame spacing of 20 inches. A damage tolerance study was conducted on the two-frame panel by cutting a notch in the panel that originates at the edge of a cutout and extends in the panel hoop direction through the window-belt area. This panel with a notch was tested in a combined-load condition to demonstrate the structural damage tolerance at the design limit load condition. Both sandwich panel designs satisfied all load requirements in the experimental part of the study, and experimental results from the two-frame panel with and without damage are fully explained by the analytical results. The potential for using sandwich structural concepts with greater than the usual 20-inch-wide frame spacing, to reduce aircraft fuselage structural weight, is suggested.

Author (AIAA)

Fuselages; Sandwich Structures; Internal Pressure; Axial Loads; Tensile Stress; Composite Materials

19980072686

Flutter margin evaluation in discrete-time system

Torri, Hiroshi, Meijo Univ., Japan; Matsuzaki, Yuji, Nagoya Univ., Japan; 1998, pp. 229-236; In English

Report No.(s): AIAA Paper 98-1724; Copyright; Avail: AIAA Dispatch

In most flutter testing, a modal damping has been used as a stability criterion. The damping, however, is not always an appropriate predictor of the flutter speed. A new flutter stability parameter is proposed which is defined in the discrete time domain and is easy to evaluate from the ARMA model identified from sampled data. The analytical consideration using a simple wing model with quasi-steady aerodynamics shows that the proposed parameter is approximately equivalent to the flutter margin introduced by Zimmerman and Weissenburger (1964); the parameter can therefore be expressed as a quadratic function of the dynamic pressure. It is shown from the calculation using a 2D wing with unsteady incompressible aerodynamic forces that the parameter decreases almost linearly toward zero, that is, the flutter boundary, with increasing dynamic pressure. The method is also applied to the supersonic wind tunnel flutter testing data, and is shown that an accurate and reliable prediction of the flutter boundary is given by a linear fitting.

Author (AIAA)

Flutter; Modal Response; Vibration Damping; Systems Stability; Wing Profiles

19980072688

Limit-cycle oscillation studies of a fighter with external stores

Chen, P. C., Zona Technology, Inc., USA; Sarhaddi, D., Zona Technology, Inc., USA; Liu, D. D., Arizona State Univ., Tempe; 1998, pp. 258-266; In English

Report No.(s): AIAA Paper 98-1727; Copyright; Avail: AIAA Dispatch

We examine the nonlinear aerodynamic scenario and the nonlinear structural damping (NSD) scenario as the possible cause of the F-16/limit cycle oscillation (LCO). Contrary to previous findings, factual F-16/LCO observations seem to support the NSD scenario as well. With the presumed structural damping criteria, S-domain flutter results due to a linear structural/aerodynamic model for realistic aircraft-store configurations are found to correlate well with the LCO flight test data throughout the subsonic to sonic range. An interaction model is proposed to couple the present wing-body subsonic/transonic aerodynamic methods with the NSD model in time domain, with a view to eventually predict rather than correlate LCO. The impact of NSD on LCO remains to be seen by this proposed basic research endeavor.

Author (AIAA)

Fighter Aircraft; External Stores; Vibration Damping; F-16 Aircraft; Aeroelasticity

19980072690

Accuracy issues for transonic flutter using 3-D Navier-Stokes

Gordnier, Raymond E., USAF, Research Lab., USA; Melville, Reid B., USAF, Research Lab., USA; 1998, pp. 274-284; In English

Report No.(s): AIAA Paper 98-1729; Copyright; Avail: AIAA Dispatch

This paper presents flutter computations for the AGARD 445.6 standard aeroelastic wing configuration using a fully implicit, aeroelastic Navier-Stokes solver coupled to a general, linear, second-order structural solver. This solution technique realizes implicit coupling between the fluids and structures, using a subiteration approach. Results are presented for two freestream Mach numbers, M = 0.96, where no clearly resolved shocks are present on the wing, and M = 1.141 where a shock is resolved on the aft portion of the wing. The computed flutter predictions are compared with experimental data and with previous Navier-Stokes computations for the same case. Predictions of the flutter point for the M = 0.96 case agree well with experimental data. At the higher Mach number, the present computations overpredict the flutter point, but are consistent with other computations for the same case. The sensitivity of computed solutions to grid resolution and the number of modes used in the structural solver is investigated. A comparison of computations using a standard second-order accurate central-difference scheme and a third-order upwind-biased scheme is also made.

Author (AIAA)

Transonic Flutter; Three Dimensional Flow; Navier-Stokes Equation; Aeroelasticity; Wing Profiles

19980072691

Parameter estimation of the SR-71 fuselage dynamics using an additive beam model

Iorio, Carla, West Virginia Univ., Morgantown, USA; Lind, Rick, NASA, USA; 1998, pp. 285-294; In English

Contract(s)/Grant(s): NCC2-759

Report No.(s): AIAA Paper 98-1730; Copyright; Avail: AIAA Dispatch

This paper introduces flexible dynamics into the equations of motion for an SR-71 model. An additive beam describes the elastic mode shape by superimposing multiple uniform beams so as to account for varying fuselage stiffness. The aerodynamic lift and moment coefficients are formulated to account for the dynamics of the elastic mode in the equations of motion. The resulting nonlinear aerodynamic coefficient functions are determined along with rigid body and structural terms by a parameter estimation algorithm operating on flight data. Simulated responses of this model to pilot stick inputs closely match measured flight data responses.
Author (AIAA)
Parameter Identification; Fuselages; Beams (Supports); Aerodynamic Coefficients

19980072705

Design-oriented analysis of aircraft fuselage structures

Giles, Gary L., NASA Langley Research Center, USA; 1998, pp. 406-419; In English
Report No.(s): AIAA Paper 98-1749; Copyright; Avail: AIAA Dispatch

A design-oriented analysis capability for aircraft fuselage structures that uses the equivalent plate methodology is described. This new capability is implemented as an addition to the existing wing analysis procedure in the Equivalent Laminated Plate Solution (ELAPS) computer code. The wing and fuselage analyses are combined to model entire airframes. The paper focuses on the fuselage model definition, the associated analytical formulation, and the approach used to couple the wing and fuselage analyses. The modeling approach used to minimize the amount of preparation of input data by the user and to facilitate the making of design changes is described. The fuselage analysis is based on ring and shell equations, but the procedure is formulated to be analogous to that used for plates in order to take advantage of the existing code in ELAPS. Connector springs are used to couple the wing and fuselage models. Typical fuselage analysis results are presented for two analytical models. Results for a ring-stiffened cylinder model are compared with results from conventional finite-element analyses to assess the accuracy of this new analysis capability. The connection of plate and ring segments is demonstrated using a model representative of the wing structure for a channel-wing aircraft configuration.
Author (AIAA)
Aircraft Structures; Fuselages; Structural Design; Aircraft Design

19980072710

Rapid modeling with innovative structural concepts

Blair, Max, USAF, Research Lab., USA; Hill, Stephen, TechnoSoft, Inc., USA; Weisshaar, Terrence A., Purdue Univ., USA; Taylor, Robert, Purdue Univ., USA; 1998, pp. 463-473; In English
Contract(s)/Grant(s): F33615-97-C-3216
Report No.(s): AIAA Paper 98-1755; Copyright; Avail: AIAA Dispatch

A proven general-purpose design modeling environment is customized for use in the design of aircraft concepts. This effort complements other parallel efforts to develop manufacturing objects, and is one of a series of steps toward developing high fidelity design trades between cost and performance at the highest level. Two factors make this work innovative. First, we are using an advanced design modeling environment with dependency tracking, demand-driven calculations, and run-time object creation. Secondly, we are developing a structural modeling tool which addresses structural concepts at the earliest stage of design. This model uses independent global deformation functions, obviating compatible multipart mesh generation. The design turnaround time is reduced to the point that structural layout can be addressed at the conceptual level. This is accomplished with the transformation of triangular membrane elements from local to global coordinates. The example focuses on the efficient transformation of triangular elements from local to global coordinates. This example includes maneuver control with static aeroelastic effects.
Author (AIAA)
Aircraft Design; Systems Engineering; Run Time (Computers); Structural Design; Vortex Lattice Method; Aerodynamic Loads

19980072711

A new structural approach to variable camber wing technology of transport aircraft

Bauer, Claus, Daimler-Benz AG, Germany; Martin, Willi, Daimler-Benz AG, Germany; Siegling, Hans-Friedrich, Daimler-Benz AG, Germany; Schuermann, Helmut, Darmstadt, Technische Univ., Germany; 1998, pp. 474-482; In English
Report No.(s): AIAA Paper 98-1756; Copyright; Avail: AIAA Dispatch

This paper presents a concept for an adaptive flap structure developed by Daimler-Benz within the 'Adaptive Wing' concept. A significant contribution to the variable geometry wing is the flexible trailing edge of the flaps of future transport aircraft. In order to adapt the wing profile to specific flight conditions, the profile has to be cambered chordwise and spanwise by deflections of the flexible trailing edge. In contrast to existing design approaches, the kinematic actuation system of the presented concept

is not located within the flap but integrated into the flap support system. The major design task is to meet the stiffness requirements of the flexible trailing edge structure as a compromise; the structure must be deformable to achieve the desired deflection, yet there must be sufficient stiffness to prevent inadmissible deformations due to aerodynamic loading. Since system complexity is considerably reduced, the new design approach is a promising candidate for variable camber wing technology.
Author (AIAA)
Cambered Wings; Transport Aircraft; Flaps (Control Surfaces); Aerodynamic Loads; Deformation; Finite Element Method

19980072712

Structural and manufacturing analysis of a wing using the Adaptive Modeling Language

Zweber, Jeffrey V., USAF, Research Lab., USA; Blair, Max, USAF, Research Lab., USA; Kamhawi, Hilmi, TechnoSoft, Inc., USA; Bharatram, Geetha, MacNeal-Schwendler Corp., USA; Hartong, Alicia, Wright State Univ., USA; 1998, pp. 483-490; In English

Report No.(s): AIAA Paper 98-1758; Copyright; Avail: AIAA Dispatch

Computerized engineering architectures promise to significantly improve the process for designing complex systems. We investigate the application of the Adaptive Modeling Language to the aircraft design process. Models were developed to perform a limited activity-based cost vs structural performance trade study on a wing box. These disciplines were chosen because cost is becoming increasingly important in today’s defense industries environment, and it is not handled as systematically as the physics-based analyses by conventional aircraft design processes. Besides demonstrating the feasibility of combining diverse disciplines in a single engineering environment, we document the time savings that can be realized by automating some repetitive design tasks.
Author (AIAA)
Computer Aided Design; Aircraft Design; Aeroelasticity

19980072713

Benefits of advanced disc sizing criterion for engines of high speed aircraft

Abumeri, Galib H., NYMA, Inc., USA; Chamis, Christos C., NASA Lewis Research Center, USA; 1998, pp. 491-499; In English

Report No.(s): AIAA Paper 98-1759; Copyright; Avail: AIAA Dispatch

The benefits of introducing an advanced disk-sizing criterion to high and low pressure turbines of high speed engines are evaluated. The criterion used to size the turbine disk accounts for loads on the blade. Results from a linear elastic structural analysis of a high pressure turbine disk are presented. The implementation of the turbine disk sizing criterion in the Engine Structures Technology Benefit Estimator code produced significant reduction in the weight of both the high and the low pressure turbine. The overall engine weight is reduced by 4.5 percent. Benefits in the areas of weight, mission, cost, and maintenance obtained with the use of the disk sizing criterion are described.
Author (AIAA)
Aircraft Engines; Turbine Wheels; Structural Analysis; Engine Design; Disks (Shapes); Civil Aviation

19980072755

Implications of external stores on static and dynamic aeroelasticity of advanced aircraft wings

Gern, Frank H., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Librescu, Liviu, Virginia Polytechnic Inst. and State Univ., Blacksburg; 1998, pp. 885-895; In English

Contract(s)/Grant(s): DFG-Ge-923/1

Report No.(s): AIAA Paper 98-1804; Copyright; Avail: AIAA Dispatch

The static aeroelastic response and flutter instability of straight and swept aircraft wings carrying external stores along their span and at their tip are investigated. In this context, a comprehensive structural model for the aircraft wing, which incorporates flexibility in transverse shear, anisotropy, and warping effects, is used. The relevant equations of motion, as well as the appropriate boundary conditions, are obtained via Hamilton’s Variational Principle and application of generalized function theory in order to exactly consider the spanwise location and properties of the attached stores. to achieve a realistic representation of the stores’ influence upon the static and dynamic aeroelastic behavior of the system, static weights and dynamic inertias of the attached stores have been modeled. The obtained eigenvalue/boundary value problems are solved by application of the Extended Galerkin Method. Comparisons with the very few results highlighting the effects of underwing and tip stores on flutter instability are carried out, and excellent agreement with the present predictions is reported.
Author (AIAA)
Aeroelasticity; Wing Oscillations; External Stores; Flutter; Dynamical Systems

19980072756

Residual pitch oscillation (RPO) flight test and analysis on the B-2 bomber

Jacobson, S. B., Northrop Grumman Corp., Military Aircraft Div., USA; Britt, R. T., Northrop Grumman Corp., Military Aircraft Div., USA; Freim, D. R., Northrop Grumman Corp., Military Aircraft Div., USA; Kelly, P. D., Northrop Grumman Corp., Military Aircraft Div., USA; 1998, pp. 896-911; In English

Report No.(s): AIAA Paper 98-1805; Copyright; Avail: AIAA Dispatch

Recently, a B-2 experienced an unpredicted residual pitch oscillation (RPO) during low altitude high speed flight testing outside the operational envelope. An 11 sortie flight test program was flown to better understand the phenomenon and define the RPO on-set boundary. The oscillation was characterized by a rapid decrease in damping over a very narrow Mach number range and exhibited 'hump' mode characteristics for many configurations. Chase plane video of the B-2 during control surface excitations appeared to show a moving shock visible in the condensation cloud over the engine nacelles. Analysis of all available data indicates that the RPO is most likely induced by an oscillating shock. Augmented linear model results correlated well with frequency responses from selected flight conditions. Nonlinear modeling results showed promising comparisons with the flight data and potential for improved transonic analysis capability.

Author (AIAA)

Flight Tests; B-2 Aircraft; Computational Fluid Dynamics; Pitching Moments; Flutter Analysis

19980072758

Aeroelastic analysis of a trimmed generic hypersonic vehicle

Nydick, I., California, Univ., Los Angeles, USA; Friedmann, P. P., California, Univ., Los Angeles; 1998, pp. 923-941; In English

Contract(s)/Grant(s): NCC2-374

Report No.(s): AIAA Paper 98-1807; Copyright; Avail: AIAA Dispatch

The aeroelastic equations of motion governing a hypersonic vehicle in free flight are derived. The equations of motion for a translating and rotating flexible body using Lagrange's equations in terms of quasi-coordinates are presented. These equations are simplified for the case of a vehicle with pitch and plunge rigid body DOFs and small elastic displacements. The displacements are approximated by a truncated series of the unrestrained mode shapes, which are obtained using equivalent plate theory. Subsequently, the nonlinear equations of motion are linearized about the trimmed vehicle state in horizontal flight. Unsteady aerodynamic loads for the vehicle and the appropriate stability derivatives are calculated from piston theory. The methodology for calculating the aeroelastic stability boundaries is also described. Preliminary numerical results are presented.

Author (AIAA)

Aeroelasticity; Hypersonic Vehicles; Free Flight; Equations of Motion; Aerodynamic Loads; Unsteady Aerodynamics

19980072766

An analytical method for concept aircraft structural weight and balance prediction

Eustace, Paul A., R.E.D. Scientific, Ltd., Midhurst; Loughborough Univ. of Technology, UK; 1998, pp. 1023-1032; In English

Report No.(s): AIAA Paper 98-1816; Copyright; Avail: AIAA Dispatch

This paper presents the background, development approach, and application of an analytical method for concept aircraft structural weight and balance prediction. The method takes basic aircraft geometry and materials data available at the concept stage of design, calculates loads, and applies design based structural analysis to derive the sizes and hence weight of the major assemblies. The loads and weight of these assemblies are integrated with the sub-systems and equipment weights, loads, and layout in a whole aircraft balance sum. An example single engine fighter aircraft concept of 10 tons design mass at which it is capable of 11 g is used to demonstrate the method. Illustrative results are presented comparing a conventional design and one employing advanced materials, wing-body blending, and vectored thrust. The concept aircraft has a structure mass 79 percent of that of the conventional aluminum alloy aircraft, which may be used to increase the fuel plus payload mass by 17 percent within the 10-ton limit. The change in cg position and pitch moment of inertia are quantified, together with the design implications, the latter including new wing, fin and canard designs, lower fuselage loads, and the use of vectored thrust for dynamic maneuver rather than aircraft static balance.

Author (AIAA)

Aircraft Structures; Structural Weight; Aircraft Maneuvers; Aircraft Design

19980072767

Designing affordable lightweight airframes using structural optimization techniques

Droegkamp, M. A., Boeing Co., USA; Dry, K. S., Boeing Co., USA; Koshiba, D. A., Boeing Co., USA; Renze, S. P., Boeing Co., USA; Wilson, A. M., Boeing Co., USA; 1998, pp. 1033-1043; In English

Report No.(s): AIAA Paper 98-1817; Copyright; Avail: AIAA Dispatch

Affordable lightweight airframes optimally designed to satisfy mission requirements are key to successful aircraft programs. This paper describes structural optimization tools and techniques developed and applied by the Boeing Company's Design, Manufacturing and Producibility Simulation Project (DMAPS) and Structural Technology organization. These tools have been applied across Boeing. These structural optimization techniques incorporate commercial off-the-shelf software products supplemented by in-house developed software to address specific capabilities and needs. These tools are being used to design fighter/attack aircraft, subsonic and supersonic commercial transports, hypersonic vehicles, helicopters, spacecraft, and missiles across the country at the Boeing Company.

Author (AIAA)

Airframes; Structural Design

19980072768

Enhanced multiobjective optimization technique with application to high speed aircraft design

Rajadas, John N., Arizona State Univ., Tempe, USA; Jury, Ralph A., IV, Arizona State Univ., Tempe; Chattopadhyay, Aditi, Arizona State Univ., Tempe; 1998, pp. 1044-1054; In English

Contract(s)/Grant(s): NCC2-5150

Report No.(s): AIAA Paper 98-1818; Copyright; Avail: AIAA Dispatch

An enhanced multiobjective formulation technique, which allows specific objective functions to be emphasized during the optimization process, has been developed and demonstrated on a high-speed aircraft design application. The Kreisselmeier-Steinhauser (K-S) function approach, which has been used successfully in a variety of multiobjective optimization problems, has been modified using weight factors which enables the designer to impose increased emphasis on specific objectives during the design optimization process. The developed technique has been applied to two problems. The first is a classical three-bar truss problem, and the second is a high-speed aircraft application in which the multiobjective optimization procedure simultaneously minimizes the sonic boom and the drag-to-lift ratio of the aircraft while maintaining the lift coefficient within prescribed limits. The flow equations are solved using a 3D parabolized Navier-Stokes solver. Sonic boom analysis is performed using an extrapolation procedure. The aircraft configuration is that of a doubly swept wingbody. The results are compared with those resulting from an equally weighted K-S multiobjective optimization. Results show improvements from the equally weighted optimization in both problems.

Author (AIAA)

Optimization; Aircraft Design; Navier-Stokes Equation

19980072771

Aeroelastic and strength optimisation of a large aircraft wing with wing parameter variations

Battoo, Rupinder S., Cranfield Univ., UK; de Visser, J. A. P., Delft Univ. of Technology, Netherlands; 1998, pp. 1075-1085; In English

Report No.(s): AIAA Paper 98-1821; Copyright; Avail: AIAA Dispatch

This paper shows the effects of variation of wing area, aspect ratio, and sweep angle on the wing structural mass and flutter speeds in an optimization study of a next generation 500-600 seat commercial aircraft. The current work is a contribution to a multidisciplinary research conducted by a consortium of 12 major European aerospace manufacturers and research establishments and two prominent universities. The project is based on a large commercial aircraft wing with associated fuselage, tailplane, and fin structures, and involves a variety of structural, aerodynamic, and aeroelastic optimization studies. The work presented in this paper relates specifically to the structural and aeroelastic optimization research conducted by the authors as part of this larger research.

Author (AIAA)

Aeroelasticity; Mechanical Properties; Wing Profiles; Commercial Aircraft; Flutter Analysis

19980072804

Aeroservoelastic interaction between aircraft structural and control design schemes

Karpel, Mordechay, Technion - Israel Inst. of Technology, Haifa, Israel; Idan, Moshe, Technion - Israel Inst. of Technology, Haifa; Cohen, Daniel, Technion - Israel Inst. of Technology, Haifa; 1998, pp. 1415-1423; In English

Report No.(s): AIAA Paper 98-1864; Copyright; Avail: AIAA Dispatch

The behavior of the structural and control systems of flight vehicles are highly coupled through aeroelastic effects. An interaction module was developed to facilitate efficient transfer of models, data, and design requirements between the structural and control design schemes. The aeroelastic plant state-space equations are based on a minimum-state rational function approximation of the unsteady force coefficient matrices. The control system is defined in a way that allows incorporation of most general linear

control laws in the aeroservoelastic loop, and yet allow efficient control margin and sensitivity computations by separating between changeable gains to other control parameters. New analytical expressions for SISO and MIMO stability margins, which take advantage of the special controller representation form for incorporation in the structural design scheme, are developed.
Author (AIAA)
Aeroservoelasticity; Aircraft Structures; Control Systems Design; Structural Design; MIMO (Control Systems); SISO (Control Systems)

19980072807

Integration of a steady/unsteady wing-body aerodynamic module into ASTROS

Chen, P. C., Zona Technology, Inc., USA; Sarhaddi, D., Zona Technology, Inc., USA; Liu, D. D., Arizona State Univ., Tempe; 1998, pp. 1446-1459; In English
Contract(s)/Grant(s): F33615-96-C-3217
Report No.(s): AIAA Paper 98-1867; Copyright; Avail: AIAA Dispatch

This paper reports a new MDO development on the seamless integration of ASTROS* (Automated Structured Optimization System) with a unified steady/unsteady aerodynamics module (ZAERO). Together, they are named ASTROS*. With the unified ZAERO module, ASTROS can now perform design optimization and analysis for realistic wing-body configurations throughout the linear subsonic/supersonic and the nonlinear transonic/hypersonic flight regimes. Five cases studied for the validation of ASTROS* showing its widened applicability in all Mach number ranges are presented.
Author (AIAA)
Body-Wing Configurations; Transonic Flight; Hypersonic Flight; Supersonic Flight; Aeroservoelasticity

19980072830

Analyzing aeroservoelastic stability margins using the mu method

Lind, Rick, NASA, USA; Brenner, Marty, NASA, USA; 1998, pp. 1672-1681; In English
Report No.(s): AIAA Paper 98-1895; Copyright; Avail: AIAA Dispatch

The mu method for flutter analysis is extended to compute stability margins of aeroservoelastic dynamics. This method uses flight data to determine operators which describe errors in a model. The resulting stability margins directly account for these errors to compute a worst-case range of the flight conditions for which the aircraft is guaranteed to be free of aeroservoelastic instabilities. The mu method is used to analyze an F/A-18 aircraft and demonstrate that the stability margins of the nominal dynamics are quite large; however, accounting for modeling errors can dramatically reduce the stability margins.
Author (AIAA)
Aeroservoelasticity; Flutter Analysis; Aircraft Stability; F-18 Aircraft

19980072831

Wavelet filtering to reduce conservatism in aeroservoelastic robust stability margins

Brenner, Marty, NASA, USA; Lind, Rick, NASA, USA; 1998, pp. 1682-1693; In English
Report No.(s): AIAA Paper 98-1896; Copyright; Avail: AIAA Dispatch

Wavelet analysis for filtering and system identification was used to improve the estimation of aeroservoelastic stability margins. The conservatism of the robust stability margins was reduced with parametric and nonparametric time-frequency analysis of flight data in the model validation process. Nonparametric wavelet processing of data was used to reduce the effects of external disturbances and unmodeled dynamics. Parametric estimates of modal stability were also extracted using the wavelet transform. Computation of robust stability margins for stability boundary prediction depends on uncertainty descriptions derived from the data for model validation. F-18 High Alpha Research Vehicle aeroservoelastic flight test data demonstrated improved robust stability prediction by extension of the stability boundary beyond the flight regime.
Author (AIAA)
Wavelet Analysis; Aeroservoelasticity; F-18 Aircraft; Modal Response; Aircraft Models

19980072832

Reduced order dynamic aeroelastic model development and integration with nonlinear simulation

Winther, B. A., Boeing Co., USA; Goggin, P. J., Boeing Co., USA; Dykman, J. R., Boeing Co., USA; 1998, pp. 1694-1704; In English
Report No.(s): AIAA Paper 98-1897; Copyright; Avail: AIAA Dispatch

Piloted and batch simulations of the aeroservoelastic response are essential tools in the development of advanced FCSs. In these simulations the number of differential equations must be sufficiently large to yield the required accuracy, yet small enough

to enable real-time evaluations of the aircraft flying qualities. The challenge of these conflicting demands is reinforced by nonlinearities in the quasi-steady equations of motion and by the complex characteristics of the oscillatory forces. Our solution to the problem is based on a unique formulation that eliminates the need for auxiliary state variables to represent the unsteady aerodynamics. We also address transformations from the mean flight path axes to a body axes coordinate system and describe how the structural dynamic equations of motion are integrated with the quasi-steady, nonlinear, 6-DOF plant model. The unified model, which accurately preserves the roots of the dynamic aeroelastic system, includes provisions for control surface inputs and atmospheric turbulence.
Author (AIAA)
Aeroelasticity; Computerized Simulation; Aerodynamic Forces

19980072833

Aeroservoelasticity in compressible flow and its scaling laws

Presente, E. H., California, Univ., Los Angeles, USA; Friedmann, P. P., California, Univ., Los Angeles; 1998, pp. 1705-1720; In English

Contract(s)/Grant(s): F49620-94-1-0400

Report No.(s): AIAA Paper 98-1899; Copyright; Avail: AIAA Dispatch

Active flutter suppression of a 2D wing section in compressible flow is studied. The equations of motion of a typical section are presented in nondimensional form. A 2-DOF problem, with pitch and plunge dynamics, combined with a trailing-edge control surface, is considered. Aerodynamic loads for compressible flow, are expressed in the time domain using Roger’s approximation. Linear optimal control is used to design a full-state feedback regulator for flutter suppression. Constraints on actuator deflection and rate limit the flutter envelope expansion. Aeroservoelastic scaling is addressed, and scaling parameters required for maintaining similarity between a full-scale system and its model are identified. Results illustrate system behavior in subsonic flow. Approximate relations comparing an actively controlled flap with a twisted wing section, using piezoelectric actuation, are obtained and used to compare the performance of these two systems. Suboptimal aeroservoelastic control algorithms for cases with control saturation are also addressed in a preliminary manner.
Author (AIAA)
Aeroservoelasticity; Compressible Flow; Scaling Laws; Flutter; Aerodynamic Loads; Control Systems Design

19980072842

Aeroelastic optimization of a composite tilt rotor

Soykasap, Omer, Georgia Inst. of Technology, Atlanta, USA; Hodges, Dewey H., Georgia Inst. of Technology, Atlanta; 1998, pp. 1803-1812; In English

Report No.(s): AIAA Paper 98-1919; Copyright; Avail: AIAA Dispatch

Composite tilt rotor aeroelastic optimization is performed by using a mixed variational formulation based on exact intrinsic equations of motion for moving beams and a finite-state dynamic inflow theory. A composite box-beam model is used to represent the principal load carrying member of the rotor blade. The blade is discretized using finite elements. Each wall used to model the box beam is made of 24 laminated orthotropic composite plies. For the optimization, design variables are blade twist, box width and height, horizontal and vertical wall thicknesses, the ply angles of the laminated walls, and nonstructural mass. The rotor is optimized for the figure of merit in hover and the axial efficiency in forward flight while keeping the same thrust levels in both flight modes. Blade weight, autorotational inertia, geometry, and aeroelastic stability are considered as constraints. The feasible direction technique is used for optimization. Results are presented for effects such as extension-twist coupling, choice of layups, and cross-sectional geometry of the blade.
Author (AIAA)
Tilt Rotor Aircraft; Aircraft Design; Composite Structures; Dynamic Structural Analysis; Aeroelasticity

19980072847

Piezoceramic active vibration suppression flight demonstration program on the B-1B aircraft

Larson, Charles R., Boeing North America, USA; Rosenthal, Joseph H., Boeing North America, USA; Falangas, Eric, Boeing North America, USA; Dobbs, Steven K., Boeing North America, USA; Neurgoankar, Ratnakar R., Rockwell Science Center, USA; Nelson, Jeffrey G., Rockwell Science Center, USA; Hustedde, Cindy L., USAF, USA; McGrath, Stephen F., USAF, USA; 1998, pp. 1847-1856; In English

Report No.(s): AIAA Paper 98-1926; Copyright; Avail: AIAA Dispatch

This paper describes a program which applied a set of PZTs to a skin panel on the aft fuselage of the B-1B aircraft. The overall objective of this program was to demonstrate that an active vibration suppression system could reduce the vibration levels of a

thick sharply-curved aircraft skin panel with PZT actuators attached only on the inner surface. The program was performed in three stages. The first stage included laboratory tests to develop the hardware and software. The second stage of the program included designing, fabricating, assembly, and installing all of the equipment in the aircraft for the active vibration suppression system. The third stage of the program was the actual flight test of the system on the aircraft during takeoff and significant flight conditions. Vibration data collected on the aircraft was reduced and analyzed to show the panel response with and without the system operating. The system was successful in reducing the fundamental panel vibration as much as 79 percent for the takeoff condition and about 46 percent for flight conditions. The paper presents a discussion of each stage of the development of the system and the active vibration suppression system performance.
Author (AIAA)
B-1 Aircraft; Vibration Damping; Active Control; Flight Tests

19980072869

Nonlinear aeroelastic analysis of aircraft with high-aspect-ratio wings

Patil, Mayuresh J., Georgia Inst. of Technology, Atlanta, USA; Hodges, Dewey H., Georgia Inst. of Technology, Atlanta; Cesnik, Carlos E. S., MIT, USA; 1998, pp. 2056-2068; In English

Report No.(s): AIAA Paper 98-1955; Copyright; Avail: AIAA Dispatch

The paper describes a formulation for aeroelastic analysis of aircraft with high-aspect-ratio wings. The analysis is a combination of a geometrically-exact mixed formulation for the dynamics of moving beams and finite-state unsteady aerodynamics with the ability to model dynamic stall. The analysis also takes into account gravitational forces, propulsive forces, and rigid-body dynamics. The code is validated against the exact flutter speed of the 'Goland' wing. Further results are obtained which give insight into the effects of the structural and aerodynamic nonlinearities on the trim solution and flutter speed.
Author (AIAA)

Aircraft Design; Aeroelastic Research Wings; Dynamic Structural Analysis; Slender Wings; Unsteady Aerodynamics; Aerodynamic Stalling

19980072870

Spatial characteristics of F/A-18 vertical tail buffet pressures measured in flight

Moses, Robert W., NASA Langley Research Center, USA; Shah, Gautam H., NASA Langley Research Center, USA; 1998, pp. 2069-2078; In English

Report No.(s): AIAA Paper 98-1956; Copyright; Avail: AIAA Dispatch

Previous wind-tunnel and flight tests were conducted to characterize the buffet loads on the vertical tails by measuring surface pressures, bending moments, and accelerations. Following these tests, buffeting estimates were computed using the measured buffet pressures and compared to the measured responses. The estimates did not match the measured data because the assumed spatial correlation of the buffet pressures was not correct. A better understanding of the partial (spatial) correlation of the differential buffet pressures on the tail was necessary to improve the buffeting estimates. Several wind-tunnel investigations were conducted for this purpose. When combined and compared, the results of these tests show that the partial correlation depends on, and scales with, flight conditions. One of the remaining questions is whether the wind-tunnel data are consistent with flight data. Cross-spectra and coherence functions calculated from pressures that were measured on the High Alpha Research Vehicle (HARV) indicate that the partial correlation of the buffet pressures in flight agrees with the partial correlation observed in the wind tunnel.
Author (AIAA)

F-18 Aircraft; Stabilizers (Fluid Dynamics); Pressure; Flight Tests; Aeroelasticity

19980072871

Time varying effects on the buffet response of a scaled F/A-18 vertical tail

Liguore, Salvatore, Boeing Co., USA; Drouin, Donald, Boeing Co., USA; 1998, pp. 2079-2087; In English

Report No.(s): AIAA Paper 98-1958; Copyright; Avail: AIAA Dispatch

A wind tunnel experiment using a 15 percent scaled F/A-18E model was performed for the purpose of quantifying the effects of pitch rate on buffet loads and response. Tests were performed at dynamic pressures of 1.5 to 10.0 psf and simulated a symmetric pull-up maneuver by pitching-up the model at rates of 7 deg/s. Results indicate that the nature of the buffeting changes during a pull-up maneuver. In general, buffeting is a function of dynamic pressure and angle-of-attack. However, pitching the model decreases buffeting loads over measured static conditions. In addition, the center frequency of the buffet excitation increases with

pitch rate. This effect on the buffet pressures changes the response of the tail by shifting the peak buffet response to higher angles of attack.
Author (AIAA)
F-18 Aircraft; Buffeting; Stabilizers (Fluid Dynamics); Wind Tunnel Tests; Static Aerodynamic Characteristics; Aerodynamic Loads

19980072884
Operational supportability demonstration of ultra-lightweight structure with suppressed electromagnetic signature
Dolvin, Douglas J., USAF, Research Lab., USA; Augustine, Thomas W., Boeing Military Aerospace, USA; 1998, pp. 2210-2217; In English
Report No.(s): AIAA Paper 98-1871; Copyright; Avail: AIAA Dispatch

The technical work reported herein was performed for the development and transition of LO-compatible structures technologies. The objective of this effort was to develop the design of durable and supportable high temperature radar absorbing structure and demonstrate applicability to regions of tactical aircraft which are impinged by exhaust flows at high temperature and high acoustic levels. The structural and electrical designs of an exhaust washed elevon were developed employing a passively cooled primary load box of conventional composites and radar absorbing structural edges of both epoxy and high temperature composite (AFR700) materials. A component-level logistics support analysis was performed concurrent with the design development effort to ensure military operational requirements, and maintenance procedures were addressed. Trade studies were performed to quantify dependences between structural stiffness and low observables performance and assess sensitivities to goal performance levels. The elevon design was fabricated to demonstrate producibility of the hybrid structural concept and then tested to quantify low observables performance. The restoration of low observables performance was validated with radar cross section testing.
Author (AIAA)
Radar Absorbers; Thermal Stability; Electromagnetic Interference; Aircraft Structures; Exhaust Gases

19980072886
Robust composite sandwich structures
Sheahen, Patrick, Lockheed Martin Tactical Aircraft Systems, USA; Bersuch, Larry, Lockheed Martin Tactical Aircraft Systems, USA; Holcombe, Tom, USAF, Wright Lab., USA; Baron, Bill, USAF, Wright Lab., USA; 1998, pp. 2228-2238; In English
Report No.(s): AIAA Paper 98-1873; Copyright; Avail: AIAA Dispatch

The Robust Composite Sandwich Structure (ROCSS) Program is being conducted to investigate and demonstrate sandwich core structural concepts for advanced aircraft and missile applications. The purpose of the study is to develop materials with potential to replace conventional honeycomb sandwich structures with upgraded materials that improve manufacturability and supportability. Conventional honeycomb sandwich structures offer a high level of structural efficiency, but airframe integration is typically limited by manufacturing and supportability costs. Improvements in these areas are needed to meet demanding performance requirements established for future fighter airframes, which will largely be constructed of composites. During the ROCSS Program, a full-scale component will be designed, fabricated, and tested with the new materials. The entire component, a representation of an F-22 center fuselage section, will be designed using sandwich structures for bulkheads, skins, and inlet ducts. Three-dimensional textile preforms will be integrated into sandwich structure joints, providing a means of efficiently joining primary sandwich structures with minimal mechanical fastening.
Author (AIAA)
Composite Structures; Sandwich Structures; Aircraft Design; F-22 Aircraft; Aircraft Stability

19980072889
The effects of segmented piezoelectric actuator configuration on aircraft noise control performance
Xu, W., Carleton Univ., Canada; Afagh, F. F., Carleton Univ., Canada; Grewal, A., NRC of Canada, Inst. for Aerospace Research, Ottawa; Zimcik, D., NRC of Canada, Inst. for Aerospace Research, Ottawa; 1998, pp. 2257-2264; In English
Report No.(s): AIAA Paper 98-1978; Copyright; Avail: AIAA Dispatch

A study of the Active Structural Acoustic Control (ASAC) of a full-scale deHavilland Dash-8 series 100 fuselage is presented. Piezoceramic elements bonded on the fuselage were used for structural actuation. Using two separate approaches to error sensing, 12 accelerometers were used in one case, whereas three microphones were employed in the second approach. MIMO feedforward control was carried out using the filtered-x least mean square adaptive algorithm. The propeller acoustic field on the port side of the aircraft was simulated using a sound source consisting of four loudspeakers. The operating deflection shapes for the fuselage in the vicinity of the propeller plane were measured. Based on these measurements, the placement of piezoelectric actuators was optimized and experimentally verified. The vibration and noise control strategy was implemented on the full-scale aircraft with

the objective of reducing the noise and vibration levels at the propeller blade passage frequency and its harmonics. The effectiveness of the control was demonstrated by achieving reductions as high as 21.6 dB in the fuselage vibration and 25.8 dB in interior sound field.
Author (AIAA)
Aircraft Noise; Noise Reduction; MIMO (Control Systems); Fuselages; Feedforward Control

19980072890

Application of feedforward and feedback structural control for aircraft cabin noise reduction

Grewal, A., NRC of Canada, Inst. for Aerospace Research, Ottawa, Canada; Pavel, L., NRC of Canada, Inst. for Aerospace Research, Ottawa; Zimcik, D. G., NRC of Canada, Inst. for Aerospace Research, Ottawa; Leigh, B., de Haviland, Inc., Canada; Xu, W., Carleton Univ., Canada; 1998, pp. 2265-2275; In English
Report No.(s): AIAA Paper 98-1979; Copyright; Avail: AIAA Dispatch

The use of feedback and adaptive feedforward control within the Active Structural Acoustic Control (ASAC) framework is applied to the problem of propeller-induced noise and vibration reduction in the passenger cabin of the de Havilland Dash-8 aircraft. Piezoceramic elements are used for structural actuation, and either vibration or acoustic sensing is employed. Actuators comprised of segmented piezoelectric elements are designed with the objective of reducing the noise and vibration levels at the propeller blade passage frequency (BPF) and the first harmonic. The actuator design objective was suppression of the operating deflection shapes (ODS) of the fuselage at the various frequencies by the judicious placement of piezoelectric elements. Using an identical actuator and sensor design optimized for the BPF, the feedback and feedforward controllers are found to yield similar results in vibration attenuation for the case of vibration sensing. The correlation in noise reduction is weaker between the two cases, although noise reduction performance is very good in both cases.
Author (AIAA)
Aircraft Noise; Feedforward Control; Aircraft Compartments; Propeller Noise; Feedback Control; Noise Reduction

19980072909

Rotorcraft blade lag damping using highly distributed tuned vibration absorbers

Hebert, Chad A., Pennsylvania State Univ., University Park, USA; Lesieutre, George A., Pennsylvania State Univ., University Park; 1998, pp. 2452-2457; In English
Report No.(s): AIAA Paper 98-2001; Copyright; Avail: AIAA Dispatch

Lag damping is typically provided by hydraulic or elastomeric dampers. An alternative approach to providing damping over a broadband frequency range is presented. This is accomplished with multiple individual vibration absorbers which are highly distributed, both in space and in frequency. The mass for the absorbers could perhaps come from a portion of the mass of the leading edge weight structure already incorporated into the blade. The absorber system is modeled as frequency-dependent mass which is distributed continuously along an elastic blade. The amount of damping can be controlled by varying the number of discrete tuning frequencies, the mass per unit length of the absorber system, the loss factor of the spring material, and the frequency range of the absorbers. Through careful selection of these design parameters, substantial damping over a broad frequency range may be obtained. In an initial concept, these absorbers are embedded inside the blade leading edge weight structure, which reduces total rotor weight, complexity, and drag. In addition, future research issues critical to the effective implementation of this concept are addressed.
Author (AIAA)
Rotary Wing Aircraft; Vibration Isolators; Rotary Wings

19980072910

Helicopter dynamic stall suppression using piezoelectric active fiber composite rotor blades

Wilkie, W. K., NASA Langley Research Center, USA; Belvin, W. K., NASA Langley Research Center, USA; Park, K. C., Colorado, Univ., Boulder; 1998, pp. 2458-2472; In English
Report No.(s): AIAA Paper 98-2002; Copyright; Avail: AIAA Dispatch

An analytical effort to examine the effectiveness of embedded piezoelectric active fiber composite laminae for alleviating adverse vibratory loads on helicopter rotor blades at high-speed, high-thrust forward flight conditions is detailed. Structural and piezoelectric actuation properties for a conceptual full-scale active fiber composite rotor blade are developed using a classical laminated plate theory approach. A numerical rotor blade aeroelastic analysis program is used to calculate the out-of-plane bending and torsional dynamic responses of the active fiber composite blade, both with and without piezoelectric twist control. Dynamic stall limited maximum rotor thrust vs forward flight speed trends for the active fiber composite blade are compared with those of a baseline, conventional rotor blade structure. Maximum stall limited rotor thrust using active blade twisting is approxi-

mately 5 to 10 percent greater than that achievable with the conventional passive blade structure. A corresponding 10-15 percent increase in dynamic stall limited forward flight speed is also shown using the active fiber composite blades.
Author (AIAA)
Aerodynamic Stalling; Fiber Composites; Rotary Wings; Piezoelectric Transducers

19980072911
Linear and nonlinear damping identification in helicopter rotor systems
Smith, Clifford B., Maryland, Univ., College Park, USA; Wereley, Norman M., Maryland, Univ., College Park; 1998, pp. 2473-2485; In English
Contract(s)/Grant(s): DAAL03-92-G-0121
Report No.(s): AIAA Paper 98-2003; Copyright; Avail: AIAA Dispatch

This paper focuses on three analyses for identifying damping from transient test data: an FFT-based moving block analysis, an analysis based on a periodic Fourier series decomposition, and a Hilbert-transform-based technique. Analytical studies are used to determine the effects of block length, noise, and error in identified frequency on the accuracy of the identified damping level. These analyses are applied to transient data associated with single-DOF systems having linear viscous damping, as well as nonlinear Coulomb and quadratic damping. The FFT-based moving block analysis performs well for linear viscous damping, but has unacceptable performance for systems with nonlinear damping. These problems are remedied in the Fourier-series-based analysis, and acceptable performance is obtained for nonlinear damping identification from both this technique and the Hilbert-transform-based method.
Author (AIAA)
Vibration Damping; Rotary Wings

19980072912
Saturation control for suppressing helicopter blade flapping vibrations - A feasibility study
Kunz, Donald L., Old Dominion Univ., USA; 1998, pp. 2486-2493; In English
Report No.(s): AIAA Paper 98-2004; Copyright; Avail: AIAA Dispatch

The feasibility of using saturation control for the suppression of helicopter rotor blade flapping vibrations was investigated. In order to simplify the equations of motion, the flapping equation for a rigid blade in hover was used for the plant. A perturbation analysis was performed to obtain an analytical result, and numerical simulations of various configurations were run. The principal characteristics of vibration control using saturation that are discussed herein are sensitivity to plant frequency and plant damping. For the range of rotating natural frequencies typical of modern helicopters, saturation control could be effective as a means for suppressing blade flapping vibration. However, the levels of flap damping present are much too high for saturation control to be effective.
Author (AIAA)
Vibration Damping; Rotary Wings; Flapping; Hovering

19980072914
Individual blade control for alleviation of helicopter ground resonance
Hathaway, Eric, Pennsylvania State Univ., University Park, USA; Gandhi, Farhan, Pennsylvania State Univ., University Park; 1998, pp. 2507-2517; In English
Report No.(s): AIAA Paper 98-2006; Copyright; Avail: AIAA Dispatch

Individual blade control (IBC) through blade root pitch actuation in the rotating system, based on rotor state feedback, is investigated as a means to alleviate ground resonance instability. Formal optimization techniques are used on two different model rotors to determine a combination of controller gains, for each rotor, that will alleviate resonance over a broad range of conditions. For both model rotors considered, IBC stabilized ground resonance over a wide range of rotational speeds and collective pitch values. The robustness of these IBC schemes is verified by their continued effectiveness in case of changes in fuselage inertia. IBC is shown to have a greater stabilizing effect on ground resonance than either aeroelastic couplings or active control through the swashplate based on fuselage state feedback. The optimized IBC used to alleviate ground resonance was found to improve aeromechanical stability in hover.
Author (AIAA)
Ground Resonance; Feedback Control; Helicopter Control; Control Systems Design

19980072915

The Active Aeroelastic Wing Flight Research Program - Technical program and model analytical development

Pendleton, Ed, USAF, Air Vehicles Directorate, USA; Bessette, Denis, NASA, USA; Field, Pete, Boeing-Phantom Works, USA; Miller, Gerry, Boeing-Phantom Works, USA; Griffin, Kenneth, Southwest Research Inst., USA; 1998, pp. 2518-2531; In English

Report No.(s): AIAA Paper 98-1972; Copyright; Avail: AIAA Dispatch

This paper describes the Active Aeroelastic Wing (AAW) Flight Research Program's technical content and summarizes analytical model development through March 1998. Goals of the AAW Flight Research Program are to demonstrate, in full scale, key AAW parameters and to measure the aerodynamic, structural, and flight control characteristics associated with AAW. Design guidance, derived from the results of this benchmark flight program, will be provided for implementation on future aircraft designs.

Author (AIAA)

Aeroelasticity; Flight Control; Active Control; Aircraft Design; Wing Profiles

19980072918

Development of failure criteria for dynamic high cycle fatigue of ceramic matrix composites

Wolfe, Howard F., USAF, Flight Dynamics Directorate, USA; Byrd, Larry W., USAF, Flight Dynamics Directorate, USA; Camden, M. P., USAF, Flight Dynamics Directorate, USA; Simmons, L. W., USAF, Flight Dynamics Directorate, USA; Paul, Donald B., USAF, Flight Dynamics Directorate, USA; Kim, Ran, Dayton, Univ.; USAF, Materials Directorate, USA; 1998, pp. 2550-2558; In English

Report No.(s): AIAA Paper 98-1976; Copyright; Avail: AIAA Dispatch

This paper looks at developing criteria for a relatively new class of materials, ceramic matrix composites, which are characterized by having a brittle matrix, which has a stiffness that is a significant fraction of the fiber value. Also discussed are experimental techniques that can reduce the scatter associated with such data.

Author (AIAA)

Failure Modes; Fatigue Tests; Cyclic Loads; Ceramic Matrix Composites; Acoustic Fatigue; Excitation

19980072948

Bench-top characterization of an active rotor blade flap system incorporating C-block actuators

Clement, Joseph W., Michigan, Univ., Ann Arbor, USA; Brei, Diann, Michigan, Univ., Ann Arbor; Moskalik, Andrew J., Michigan, Univ., Ann Arbor; Barrett, Ron, Auburn Univ., USA; 1998, pp. 2857-2869; In English

Report No.(s): AIAA Paper 98-2108; Copyright; Avail: AIAA Dispatch

This paper presents the bench-top testing of a piezoceramic C-block driven active flap system designed to suppress the vibrations of a helicopter rotor blade. The C-block actuators are curved benders designed to generate a larger force output than a straight bender, while providing deflections large enough to eliminate the need for external leveraging systems necessary with stack driven systems. The actuators power a balanced active flap designed to minimize the effect of air speed and rotor speed on flap deflection. Quasi-static experimentation at 1 Hz produced maximum angular flap deflections of 8.4 deg peak-to-peak. Dynamic tests were conducted over a 40-Hz frequency range demonstrating the ability to generate significant flap deflections both before and after the first natural frequency. Over the 40-Hz range, the flap deflections never dropped below 8 deg pp, with a first natural frequency of 27 Hz. The flap deflection reached a maximum value of 13.6 deg pp at 40 Hz. If the applied voltage is increased to the maximum allowable level, it is predicted that flap deflections as large as 20 deg pp can be achieved.

Author (AIAA)

Rotor Blades; Flaps (Control Surfaces); Actuators

19980072955

Failure probability of a composite aircraft wing structure

Liu, X., Vanderbilt Univ., USA; Mahadevan, S., Vanderbilt Univ., USA; 1998, pp. 2923-2930; In English

Report No.(s): AIAA Paper 98-2048; Copyright; Avail: AIAA Dispatch

A system-reliability-based practical and efficient probabilistic method is proposed to predict the composite structural ultimate strength failure probability. A fast branch and bound method is incorporated to speed up the search for important failure paths. Numerical analysis of a practical composite aircraft wing is implemented in a Sun workstation by means of ANSYS 5.3 version for UNIX, and the structural ultimate failure probability is estimated. Ply-level failure modes, such as matrix cracking, fiber failure, and delamination, are considered, and system degradation due to progressive failure is modeled. The system failure

probability is computed using the dominant failure sequences, and several practical strategies for computational efficiency and simplicity are proposed.
Author (AIAA)
Wing Profiles; Aircraft Structures; Failure Modes; Probability Theory; Composite Structures; Structural Design

19980072967
Virtual Product Development - Case study of the T-45 horizontal stabilator
Price, Andrew M., Boeing Co., USA; 1998, pp. 3041-3051; In English
Report No.(s): AIAA Paper 98-2065; Copyright; Avail: AIAA Dispatch

The Virtual Product Development (VPD) process relies on 3D master solid models and a variety of advanced analysis, simulation, and modeling tools. The result is a process that virtually verifies the entire product design, tooling, and manufacturing processes prior to fabricating parts or tools. Boeing applied the VPD processes to a redesign of the T-45 horizontal stabilator. This project demonstrated that 3D master modeling could eliminate 2D drawings and enable physical mockups to be replaced by computer-generated virtual prototypes. The project also demonstrated the use of several advanced simulation tools for the product's design, tooling, and manufacturing processes. These tools enabled the multidisciplined stabilator team to accurately assess the most efficient manufacturing methods. They also provided simulation-based work instructions for shop personnel. When comparing the T-45 stabilator to similar production projects, Boeing achieved: a 62 percent reduction in product development time; a 42 percent reduction in development costs; a 61 percent reduction in engineering rework; a 45 percent reduction in manufacturing labor hours; and an 84 percent reduction in part nonconformance, yielding increased product quality.
Author (AIAA)
Product Development; Structural Design; Horizontal Tail Surfaces; Aircraft Design; Computer Aided Design

19980072972
Application of the transpiration method for aeroservoelastic prediction using CFD
Stephens, Cole H., Oklahoma State Univ., Stillwater, USA; Arena, Andrew S., Jr., Oklahoma State Univ., Stillwater; Gupta, Kajal K., NASA, USA; 1998, pp. 3092-3099; In English
Contract(s)/Grant(s): NCC2-5105
Report No.(s): AIAA Paper 98-2071; Copyright; Avail: AIAA Dispatch

This paper illustrates the implementation of the transpiration boundary condition in steady and unsteady aeroelastic and aeroservoelastic simulations. For two reference cases, the AGARD 445.6 wing and the BACT wing with a finite-span flap, application of the transpiration method has demonstrated the effectiveness of applying the transpiration boundary condition at a variety of Mach numbers on configurations of practical interest. Additionally, the effectiveness of the transpiration method is demonstrated by its ability to model large-scale continuous and discontinuous surface deflections without the computational expense of remeshing at each CFD time-step.
Author (AIAA)
Aeroservoelasticity; Computational Fluid Dynamics; Wing Profiles

19980072973
Calculation of corrections to linear aerodynamic methods for static and dynamic analysis and design
Baker, Myles L., Boeing Co., USA; Yuan, Kuo-An, Boeing Co., USA; Goggin, Patrick J., Boeing Co., USA; 1998, pp. 3100-3110; In English
Report No.(s): AIAA Paper 98-2072; Copyright; Avail: AIAA Dispatch

Nonlinear aerodynamics significantly influence the flight loads and aeroelastic stability of current and proposed transport aircraft. Direct simulation of the nonlinear aerodynamics with CFD codes, while technically possible, is economically impractical due to the large number of conditions which must be analyzed. While techniques exist for addresssing these nonlinear effects in production analysis for conventional configurations, the available techniques are sometimes inaccurate, and are not directly applicable to advanced configurations, such as High Speed Civil Transport (HSCT) or Blended Wing Body designs. A technique is presented that uses a small number of CFD solutions or wind tunnel test results along with linear aerodynamic theory to generate linearized aerodynamic models for use in production aeroelastic analysis and design. The technique is applied to the steady aeroelastic loads analysis of an HSCT configuration, and to the flutter analysis of an isolated wing.
Author (AIAA)
Aeroelasticity; Aircraft Design; Computational Fluid Dynamics; Wind Tunnel Tests; Flutter Analysis

19980072975

Integration of high fidelity structural analysis into parallel multidisciplinary aircraft analysis

Eldred, Lloyd B., NASA Ames Research Center, USA; Byun, Chansup, NASA Ames Research Center, USA; Guruswamy, Guru P., NASA Ames Research Center, USA; 1998, pp. 3122-3128; In English

Contract(s)/Grant(s): NAS2-14109

Report No.(s): AIAA Paper 98-2075; Copyright; Avail: AIAA Dispatch

A high fidelity parallel static structural analysis capability is created and interfaced to the multidisciplinary analysis package ENSAERO-MPI of Ames Research Center. This new module replaced ENSAERO's lower fidelity simple finite element and modal modules. Full aircraft structures may be more accurately modeled using the new finite element capability. Parallel computation is performed by breaking the full structure into multiple substructures. This approach is conceptually similar to ENSAERO's multizonal fluid analysis capability. The new substructure code is used to solve the structural finite element equations for each substructure in parallel. NAS TRAN/COSMIC is utilized as a front end for this code. Its full library of elements can be used to create an accurate and realistic aircraft model. It is used to create the stiffness matrices for each substructure. The new parallel code then uses an iterative preconditioned conjugate gradient method to solve the global structural equations for the substructure boundary nodes. Results are presented for a wing-body configuration.

Author (AIAA)

Structural Analysis; Aircraft Structures; Aircraft Models; Aeroelasticity

19980072993

Hover testing of an active rotor blade tip and structural analysis of the actuator beam

Bernhard, Andreas P. F., Maryland, Univ., College Park, USA; Chopra, Inderjit, Maryland, Univ., College Park; 1998, pp. 3299-3325; In English

Contract(s)/Grant(s): DAAL03-92-G-0121; DAAH04-96-10334

Report No.(s): AIAA Paper 98-2097; Copyright; Avail: AIAA Dispatch

This paper presents the continued development of an active on-blade vibration-reduction system using smart active blade tips (SABT) that are driven by a piezo-induced bending-torsion coupled actuator. A Vlasov-based, specialized 1D finite bar-element is developed to model the (nonrotating) actuator beam and is validated with the free-vibration and static forced response of 8:1 and 2:1 aspect ratio bending-torsion coupled plates. The FEM overpredicts the actuator torsional frequency by 4 percent, and accurately captures the actuator dynamics up to 60 Hz. In hover, at thrust coefficient of 0.0035, and for an activation of 100 V(rms) the SABT deflection ranges from 1.8 deg at 2/rev to 2.25 deg at 4/rev. The results show a distinct coupling of the activation with the first and second flap frequencies of the rotor. The corresponding dynamic thrust, generated by a single active tip, relative to the steady thrust, ranges from 4.5 percent at 2/rev to 8.3 percent at 5/rev.

Author (AIAA)

Hovering; Rotor Blades; Blade Tips; Structural Analysis; Actuators

19980072994

Development of neural network controller for smart structure activated rotor blades

Spencer, Michael G., Maryland, Univ., College Park, USA; Chopra, Inderjit, Maryland, Univ., College Park; Sanner, Robert M., Maryland, Univ., College Park; 1998, pp. 3326-3336; In English

Contract(s)/Grant(s): DAAH04-96-10334

Report No.(s): AIAA Paper 98-2099; Copyright; Avail: AIAA Dispatch

This paper explores a new, robust individual blade control (IBC) control methodology for vibration suppression using a piezo actuated trailing edge flap. The controller uses a neural network, learning in real time, to adaptively cancel the effects of periodic aerodynamic loads on the blades, greatly attenuating the resulting vibrations. A complete proof of the stability and convergence of the proposed neurocontrol strategy is provided, and numerical simulation results for a one-eighth Froude scale blade model are presented which demonstrate that the controller can virtually eliminate the blade vibration arising from a wide variety of unknown, periodic disturbance sources.

Author (AIAA)

Neural Nets; Smart Structures; Rotor Blades; Trailing Edges; Aerodynamic Loads; Vibration Damping

19980072995

An eigenstructure assignment technique for damage detection in rotating structures

Kiddy, Jason, Maryland, Univ., College Park, USA; Pines, Darryll, Maryland, Univ., College Park; 1998, pp. 3337-3346; In English

Contract(s)/Grant(s): DAAL03-92-G-0121
Report No.(s): AIAA Paper 98-2100; Copyright; Avail: AIAA Dispatch

The detection and identification of damage in a helicopter rotor blade is considered. An eigenstructure assignment technique is developed using measured modal test data and a finite element model of the blade to detect and characterize the extent of damage in the system. Additional elemental stiffness matrix terms are generated for the inboard elements due to the centrifugal force caused by the mass of the outboard elements. This force creates an enhanced sensitivity of the eigenstructure to mass changes, thereby leading to an improved damage detection capability. Feasibility of the methodology is demonstrated analytically on a finite element model of the TH-55A main rotor blade.

Author (AIAA)

Eigenvalues; Damage; Rotating Bodies; Rotary Wings

19980072997

Fatigue analysis of helicopter tail rotor spar

Schaff, Jeffery R., United Technologies Research Center, USA; Dobyns, Alan, Sikorsky Aircraft, USA; Apr. 1998; In English
Contract(s)/Grant(s): NCCW-0076
Report No.(s): AIAA Paper 98-1738; Copyright; Avail: AIAA Dispatch

A fatigue model is integrated with finite element analysis and applied to a helicopter tail rotor spar. A strength-based fatigue model is employed. The residual strength relation assumes that strength is initially equal to the static strength and decreases monotonically until failure, where failure is defined by a maximum stress failure criterion. These relations are characterized using unidirectional S-N data, laminae stiffness properties, and laminae strength properties. An algorithm was developed and a user subroutine was written to couple the fatigue model with the FEM. The tail rotor spar is modeled by the FEM using a composite layered shell element where interlaminar shear stresses are determined approximately by integrating the equilibrium equations. The residual strength and fatigue relations are applied pointwise at the integration points per layer for highly stressed elements using a user subroutine. The results are compared to the failure criterion, and 'damaged' regions are degraded by adjusting the finite element stiffness matrix based on locally reduced laminae stiffness.

Author (AIAA)

Helicopter Tail Rotors; Fatigue Tests; S-N Diagrams; Residual Strength; Finite Element Method; Helicopter Design

19980072999

Aeroelastic tailoring for improved UAV performance

Weisshaar, Terrence A., Purdue Univ., USA; Nam, Changho, Purdue Univ., USA; Batista-Rodriguez, Alicia, Purdue Univ., USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1757; Copyright; Avail: AIAA Dispatch

This paper describes how aeroelastic tailoring, in concert with optimal composite material design, might be applied to a new generation of unmanned air vehicles (UAVs) to increase range and improve lateral control effectiveness. UAV development provides a new venue for design because it encourages creativity by removing some design constraints. This paper reviews: (1) design opportunities provided by UAV missions and (2) aeroelastic tailoring features that lend themselves to improved performance. The aeroelastic features discussed in this paper are lateral control and reduced induced drag. Our studies show that aeroelastic tailoring can increase the control reversal speed of swept wings and that different laminate designs are needed depending on whether leading edge or trailing edge controls are used. We also show that induced drag can be controlled by laminate tailoring and that in some cases drag can be reduced if the wing structural aspect ratio is low, about AR=3.

Author (AIAA)

Pilotless Aircraft; Aeroelasticity; Composite Materials; Induced Drag; Aircraft Design

19980073010

Nonlinear aeroelastic and aeroservoelastic calculations for transonic wings

Bendiksen, Oddvar O., California, Univ., Los Angeles, USA; Hwang, Guang-Yaw, California, Univ., Los Angeles; Piersol, John, California, Univ., Los Angeles; Apr. 1998; In English
Contract(s)/Grant(s): NCC2-374
Report No.(s): AIAA Paper 98-1898; Copyright; Avail: AIAA Dispatch

Recent advances in massively parallel computers have made 3D nonlinear transonic flutter and aeroservoelastic simulations feasible. Nonlinear aeroelastic models are necessary in order to study LCO and certain nonclassical transonic flutter phenomena. In this paper, we consider the overall computational problem, focusing on the fluid-structure compatibility and time-synchronization requirements that must be satisfied in order to obtain a dynamically consistent aeroelastic code and to ensure that the time-

marching simulations exhibit the physically correct stability behavior. The fluid-structure system is modeled and integrated as a single dynamical system at the finite element level, and exact time synchronization is enforced. Nonlinear aeroelastic and aeroservoelastic calculations are presented for several different transonic wing models. Structural damping is incorporated using a new time-domain implementation of hysteresis damping. It is observed that structural damping is ineffective in reducing flutter amplitudes or quenching flutter, except at or near the flutter boundary.
Author (AIAA)
Wing Oscillations; Transonic Flutter; Aeroelasticity; Aeroservoelasticity; Transport Aircraft

19980073015

The Aircraft Morphing Program

Wlezien, R. W., NASA Langley Research Center, USA; Horner, G. C., NASA Langley Research Center, USA; McGowan, A. R., NASA Langley Research Center, USA; Padula, S. L., NASA Langley Research Center, USA; Scott, M. A., NASA Langley Research Center, USA; Silcox, R. J., NASA Langley Research Center, USA; Simpson, J. O., NASA Langley Research Center, USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1927; Copyright; Avail: AIAA Dispatch

The NASA Aircraft Morphing program is an attempt to couple research across a wide range of disciplines to integrate smart technologies into high payoff aircraft applications. The program bridges research in seven individual disciplines and combines the effort into activities in three primary program thrusts. System studies are used to assess the highest-payoff program objectives, and specific research activities are defined to address the technologies required for development of smart aircraft systems. In this paper we address the overall program goals and programmatic structure, and discuss the challenges associated with bringing the technologies to fruition.
Author (AIAA)
Aircraft Performance; Smart Structures; Airframes; Aircraft Construction Materials; NASA Programs; Vibration Damping

19980073019

Flight demonstration of the Twist Adaptive Wing System - Program update

Volk, John A., Northrop Grumman Corp., USA; Siler, Damin J., USAF, Research Lab., USA; Reynolds, Odell R., USAF, Research Lab., USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1971; Copyright; Avail: AIAA Dispatch

This paper describes the design, fabrication, ground testing, and upcoming flight demonstration of the Twist Adaptive Wing System (TAWS). This technology demonstration program is being executed collaboratively between the Air Force Research Laboratory (AFRL) and Northrop Grumman Corporation (NGC). The TAWS concept uses direct structural actuation of air vehicle lifting surfaces for improved performance and lower manufacturing and maintenance costs. TAWS strives to provide seamless lifting surfaces in which some or all conventional aerodynamic control surfaces are replaced with an internal mechanical system that provides differential wing twist for aerodynamic control. The concept provides range extension and load alleviation benefits as well. An AFRL-owned Uninhabited Research Vehicle (URV) has been retrofitted with TAWS wings, and is being prepared for flight testing during the summer of 1998.
Author (AIAA)
Twisted Wings; Flight Characteristics; Aircraft Design; Aircraft Performance; Flight Control

19980073021

Transient response analysis of gimballed tiltrotors during engage and disengage operations

Kang, Hao, Pennsylvania State Univ., University Park, USA; Smith, Edward C., Pennsylvania State Univ., University Park; Apr. 1998; In English
Report No.(s): AIAA Paper 98-2007; Copyright; Avail: AIAA Dispatch

An analysis has been developed to predict transient aeroelastic response of gimballed tiltrotors during shipboard engage/disengage operations. To investigate transient response of gimballed tiltrotors in more detail, the multiblade gimballed rotor is modeled with slender elastic beams rigidly attached to a hub and undergoing flap bending, lag bending, elastic twist, and axial deflection. The gimbal restraint is simulated using a conditional rotational spring. The rotor equations of motion are formulated using Hamilton's principle and spatially discretized using the FEM. The discretized rotor equations of motion are integrated in modal space for a specified rotor speed run-up or run-down profile. Blade element theory is used to calculate quasi-steady loads in linear and nonlinear regimes. Studies for a 1/5 size aeroelastically scaled tiltrotor model are conducted to validate the analysis

and investigate transient response and loads of the gimballed rotor during engagement in varying conditions. Good correlation existed between the experimental data and the prediction of blade flap and lag moments in hover condition.
Author (AIAA)
Gimbals; Tilting Rotors; Aeroelasticity; Rotor Blades; Bending Moments; Vibration Damping

19980073030
Rotary-wing aeroelastic scaling and its application to adaptive materials based actuation
Friedmann, Peretz P., California, Univ., Los Angeles, USA; Apr. 1998; In English
Contract(s)/Grant(s): DAAH04-95-1-0095; F49620-94-1-0400
Report No.(s): AIAA Paper 98-2098; Copyright; Avail: AIAA Dispatch

The aeroelastic scaling problem is revisited, and it is shown that classical aeroelastic scaling relations, developed for flutter, need to be extended when dealing with modern aeroelastic applications involving controls- and adaptive-materials-based actuation. For such problems a novel two pronged approach is presented that produces refined aeroelastic scaling laws by a judicious combination of the classical approach with more sophisticated computer simulations. It is also shown that the rotary-wing equivalent to fixed-wing aeroelastic scaling, based on typical cross-section concepts, is the offset hinged spring restrained blade model. Scaling laws for the rotary-wing aeroelastic and aeroservoelastic problem are obtained. These scaling requirements imply that scale model tests, conducted on small models intended to demonstrate active control of vibration using adaptive-materials-based actuation, use very flexible models that often disregard aeroelastic scaling. Thus, the extension of these results to the full-scale configuration is difficult.
Author (AIAA)
Rotary Wings; Aeroelastic Research Wings; Adaptive Control; Vibration Damping; Actuators; Flutter Analysis

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19980049139
YSAR - A compact, low-cost synthetic aperture radar
Thompson, Douglas G., Brigham Young Univ., USA; Arnold, David V., Brigham Young Univ., USA; Long, David G., Brigham Young Univ., USA; Miner, Gayle F., Brigham Young Univ., USA; Karlinsey, Thomas W., Brigham Young Univ., USA; Robertson, Adam E., Brigham Young Univ., USA; 1997, pp. 386-388; In English; Copyright; Avail: Aeroplus Dispatch

The Brigham Young University SAR (YSAR) is a compact, inexpensive SAR system which can be flown on a small aircraft. The system has exhibited a resolution of approximately 0.8 by 0.8 m in test flights in calm conditions. YSAR was used to collect data over archeological sites in Israel. Using a relatively low frequency (2.1 GHz), we hope to be able to identify walls or other archeological features to assist in excavation. A large data set of radar and photographic data were collected over sites at Tel Safi, Qumran, Tel Micnah, and the Zippori National Forest in Israel. We show sample images from the archeological data. We are currently working on improved autofocus algorithms for these data, and are developing a small, low-cost interferometric SAR system (YINSAR) for operation from a small aircraft.
Author (AIAA)
Low Cost; Synthetic Aperture Radar; Archaeology; Airborne Radar

19980049227
Study of the polarization behavior of complex natural and man-made clutter at middle and grazing angles
Onstott, Robert G., Michigan, Environmental Research Inst., Ann Arbor, USA; 1997, pp. 177-179; In English
Contract(s)/Grant(s): NAS1-18465; Copyright; Avail: Aeroplus Dispatch

A special mapping mission using an aircraft SAR was conducted at an airport near a large metropolitan area to characterize the clutter found in association with the airport and the surrounding area. These data were obtained specifically to support the building of a simulator for future generation radars which will operate from commercial aircraft to detect meteorological features, such as the microburst, during takeoff and landings. These data allow us to study and document the polarization and angular response behavior for a radar parameter region and clutter environment rarely studied. These behaviors are then linked to land use patterns, a topic of increasing importance for rapidly developing communities and countries with large land area.
Author (AIAA)
Clutter; Man Environment Interactions; Synthetic Aperture Radar; Airborne Radar; Airports

19980049232

The China Airborne Radar Altimeter Control System

Xu, Ke, Chinese Academy of Sciences, Center for Space Science and Applied Research, China; Li, Maotang, Chinese Academy of Sciences, Center for Space Science and Applied Research, China; Zhou, Ning, Chinese Academy of Sciences, Center for Space Science and Applied Research, China; Xue, Yonglin, Chinese Academy of Sciences, Center for Space Science and Applied Research, China; Liu, Yuesheng, Chinese Academy of Sciences, Center for Space Science and Applied Research, China; 1997, pp. 389-391; In English; Copyright; Avail: Aeroplus Dispatch

A airborne radar altimeter (ARA) was developed in China in 1995. The Airborne Radar Altimeter Control System (ARACS) is discussed in this paper. ARACS consists of an industrial control computer (ICC), a controller and a data sampling system (DSS). Besides controlling and managing the ARA, the ICC has charge of the ARA calibrating, acquiring, tracking, and data processing. The controller performs the functions of controlling the microwave switches and generating chirp controlling signals, and other controlling signals. The DSS has the functions of sampling and holding data. The ARA software consists of the initialization, noise, bias, calibration, acquisition and track program elements. The ARA trials showed satisfactory performance.
Author (AIAA)

Airborne Radar; Radio Altimeters; Numerical Control; Data Sampling

19980049268

Motion compensation effects in wavelength resolution VHF SAR interferometry

Frolind, P. O., National Defence Research Establishment, Sweden; Ulander, L. M. H., National Defence Research Establishment, Sweden; 1997, pp. 436-438; In English; Copyright; Avail: Aeroplus Dispatch

An investigation of target azimuth displacement due to motion compensation of ultrawide beam VHF SAR data is performed. The displacement is caused by a height deviation between the target and the assumed reference height. An approximate expression is derived for a line which the motion compensation inflicts on the range trajectory of the target. The azimuth displacement is illustrated for different flight tracks vs range.
Author (AIAA)

Image Motion Compensation; Wavelengths; Synthetic Aperture Radar; Very High Frequencies; Radar Maps

19980049875

Accurate height information from airborne laser-altimetry

Lemmens, Mathias J. P. M., Delft Univ. of Technology, Netherlands; 1997, pp. 423-426; In English; Copyright; Avail: Aeroplus Dispatch

High single point precision and high point density can be obtained by airborne laser-altimetry, using GPS positioning and INS attitude determination. In this paper we analyze the main error sources, including: internal laser sensor errors; GPS and INS errors; atmospheric effects; terrain roughness, reflectivity, and slope; presence, height, and type of vegetation; and integration and synchronization of laser, GPS and INS. Our analysis reveals that when laser-altimeters are well-calibrated, accuracies at decimeter level can be achieved. However, the accuracy is very sensitive to terrain type, terrain coverage, and filters used to remove undesired objects, such as buildings and trees from the DEM. In particular, pointing accuracy, which depends on the pointing jitter of the scanning mirror and INS attitude determination, is a main error source, especially over high-relief terrain. Another major problem is the automatic removal of undesired objects, such as houses.
Author (AIAA)

Airborne Lasers; Laser Altimeters; Global Positioning System; Inertial Navigation; Height

19980049876

A new airborne remote sensing system integrating scanning altimeter with infrared scanner

Liu, Zhen, Chinese Academy of Sciences, Inst. of Remote Sensing Applications, China; Li, Shukai, Chinese Academy of Sciences, Inst. of Remote Sensing Applications, China; 1997, pp. 427-429; In English; Copyright; Avail: Aeroplus Dispatch

With the development of GPS and INS, the precise position and attitude parameters of an airborne platform can be obtained. The new systems, such as INSAR and Scanning Laser Ranger, are excellent equipment for acquiring the relative height of Earth objects. At the same time optical remote sensors are making rapid progress. It is time to integrate these system into a new one, which can provide high accurate DEM and remote sensing image synchronically.
Author (AIAA)

Global Positioning System; Inertial Navigation; Remote Sensing; Flying Platforms; Altimeters; Laser Range Finders

19980049880

On the motion compensation and geocoding of airborne interferometric SAR data

Sansosti, E., CNR, Ist. di Ricerca per l'Elettromagnetismo e i Componenti Elettronici, Italy; Scheiber, R., DLR, Inst. fuer Hochfrequenztechnik, Germany; Fornaro, G., CNR, Ist. di Ricerca per l'Elettromagnetismo e i Componenti Elettronici, Italy; Tesauro, M., Napoli Federico II, Univ., Italy; Lanari, R., CNR, Ist. di Ricerca per l'Elettromagnetismo e i Componenti Elettronici, Italy; Moreira, A., DLR, Inst. fuer Hochfrequenztechnik, Germany; 1997, pp. 451-453; In English; Copyright; Avail: Aeroplus Dispatch

This paper addresses the application of motion compensation algorithms in interferometric SAR data processing. An analysis of the effects of the error induced by the flat Earth assumption in motion compensating the data is included. Possible solutions to this problem via adjustments during and after the SAR processing and the geocoding are also discussed.
Author (AIAA)

Image Motion Compensation; Airborne Radar; Synthetic Aperture Radar

19980049889

Real time synthetic aperture radar (SAR) preprocessor design via three-dimensional modular filtering architecture

Chan, Hian Lim, National Univ. of Singapore, Singapore; Yeo, Tat Soon, National Univ. of Singapore, Singapore; 1997, pp. 487-489; In English; Copyright; Avail: Aeroplus Dispatch

As part of an effort to develop a real-time Range-Doppler digital SAR processor to produce image maps of that scanned area immediately as raw data are collected, this paper describes the conceptual architecture design for a high-speed front-end video pre-filtering. The evolved architecture consists of richly interconnected planes of newly-adapted Modified Transverse FIR parallel tapped delay elements. Both the range and azimuth prefilterings are performed simultaneously in a continuous input-output flow without the need to worry about corner mining caused by azimuth preprocessing on data samples that are collected in the range direction.
Author (AIAA)

Real Time Operation; Synthetic Aperture Radar; Preprocessing; Three Dimensional Models

19980049904

Calibration experiments of the CRL/NASDA X/L-band Airborne Synthetic Aperture Radar

Satake, Makoto, Communications Research Lab., Japan; Kobayashi, Tutsuharu, Communications Research Lab., Japan; Masuko, Harunobu, Communications Research Lab., Japan; Shimada, Masanobu, NASDA, Japan; 1997, pp. 570-572; In English; Copyright; Avail: Aeroplus Dispatch

Communications Research Laboratory (CRL) and NASDA have jointly developed a new airborne SAR system operated at X- and L-band. Both the X- and L-band radars have polarimetric capability, and the X-band radar has interferometric capability. The radar system is on board a Gulfstream-2 aircraft whose navigation altitude is 20,000 to 40,000 ft. For calibration of the X-band SAR, we have developed an active radar calibrator (ARC) at CRL. The ARC is designed to return H and V radar signals simultaneously with two transmission antennas for polarimetric calibration. It will be employed, along with several corner reflectors, in calibration experiments planned in May and October 1997 at the Tottori dune area in Japan. In this paper, we address the experiments and procedure to calibrate the SAR system, focusing on the X-band SAR.
Author (AIAA)

Calibrating; Synthetic Aperture Radar; Airborne Radar

19980049971

The feasibility and benefits of dynamic reconfiguration in integrated modular avionics

Johnson, D. M., Bristol, Univ., UK; Omiecinski, T. A., Bristol, Univ., UK; Aeronautical Journal; Feb. 1998; ISSN 0001-9240; Volume 102,, no. 1012, pp. 99-105; In English; Copyright; Avail: Aeroplus Dispatch

This paper examines the feasibility of dynamic reconfiguration within the system architectures proposed by ARINC 651 and assesses the potential benefits. The analysis shows that at least two of the architectures proposed by ARINC 651 are well suited to reconfiguration and that, although there are certification problems that must be considered, these problems do not appear intractable. Significant benefits, in terms of reduced redundancy, improved availability, and higher levels of safety, can potentially be obtained. The paper also shows that reconfiguration is only required locally, within a cabinet and that large benefits are still obtainable even with relatively small cabinet sizes. This reduces the complexity and cost of any reconfiguration scheme and increases flexibility so that any reconfiguration scheme developed can be easily adapted to differing aircraft requirements. The development

of an autonomous reconfiguration scheme, in which individual modules determine their own function, is particularly attractive, as it can offer reduced susceptibility to common mode failure and provides fault tolerance within the reconfiguration process itself.
Author (AIAA)
Avionics; Architecture (Computers); Redundancy; Safety Factors; Aircraft Instruments; Fault Tolerance

19980050981

Exploiting Global Positioning System, Inertial Measurement Unit controlled image sensors

Rosiek, Mark, USAF, USA; Comer, Robert, TASC, Inc., USA; 1997, pp. 330-340; In English
Contract(s)/Grant(s): F30602-96-C-0036; Copyright; Avail: Aeroplus Dispatch

Global Positioning System (GPS) receivers and Inertial Measurements Units (IMU) are being integrated with Image Sensors. Results of this integration provide measurements on the position and attitude of the sensors. These measurements could replace the least squares method (Analytic Aerotriangulation) traditionally used to solve for the position and attitude. Direct measurement of position and attitude provide easier exploitation of imagery. Image mosaics are easier to build, digital terrain elevation data can be generated, and image registration is improved. This paper provides results of using a GPS, IMU Image Sensor. Imagery was acquired from a Kodak 460 color infrared professional digital camera and from three individually filtered progressive-scan video cameras. GPS and IMU measurement were collected at the time of image acquisition. The image sensors, GPS, and IMU equipment were flown on board a Cessna 172 aircraft. The imagery was automatically exploited to produce mosaics and to manually derive digital terrain elevation data. An optical flow technique was investigated to automate derivation of digital terrain elevation data.
Author (AIAA)
Global Positioning System; Inertial Platforms; Image Processing; Photogrammetry

19980056979

Large area E-O framing camera flight test results

Lareau, Andre G., Recon/Optical, USA; Bown, Michael R., Recon/Optical, USA; Smith, James P., Recon/Optical, USA; Knicker, John, Recon/Optical, USA; 1997, pp. 132-143; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the details of the engineering flight tests of the CA-260/25 25-Mpixel tactical reconnaissance camera, performed at Mojave, CA in August 1996. The camera's fundamentals of operation are presented, along with a comparison of features with the earlier 4-Mpixel camera. The paper discusses the purpose, equipment configuration and mission specifics, and summarizes flight test results. Examples of flight test imagery are then presented with some analysis of CA-260 performance.
Author (AIAA)
Flight Tests; Electro-Optics; Cameras; Image Motion Compensation; Reconnaissance; Aircraft Survivability

19980056982

F-14 TARPS growth architecture

Naff, Raymond A., Orbital Sciences Corp., Fairchild Defense Div., USA; 1997, pp. 153-164; In English; Copyright; Avail: Aeroplus Dispatch

The Navy's Tactical Air Reconnaissance Pod System (TARPS) flown on F-14 Tomcat aircraft has been the primary source of tactical photographic imagery for the U.S. military since its initial deployment in 1981. Recent Navy initiatives have provided critically needed operational capabilities which will enable the TARPS System to continue to meet the challenges of evolving tac recce requirements in the post-Cold War world. This paper discusses these TARPS enhancements and missions and how the new capabilities are being employed to solve the sensor-to-shooter problem. Additional TARPS growth capabilities and requirements, consistent with the guidance of Joint Vision 2010 and the Navy's TAC RECCE - 2020 STUDY recommendations, are also presented. Recommendations are provided on the continued enhancement of the F-14 TARPS capabilities, as well as the utilization of the TARPS System as a testbed to verify concepts and technologies for follow-on TAC RECCE platforms.
Author (AIAA)
F-14 Aircraft; Architecture (Computers); Aerial Reconnaissance; Target Acquisition; Electro-Optics

19980056983

Tactical Disk Recording System (TDRS)

Anderson, Donald S., Autometric, Inc., USA; Sullivan, Patrick L., Computing Devices International, USA; 1997, pp. 165-170; In English; Copyright; Avail: Aeroplus Dispatch

The Tactical Disk Recording System (TDRS) is an electronic digital recording device. It is specifically designed to record imagery data. The TDRS is capable of reliable operation in various airborne environments including high performance military

aircraft. The first TDRS application is the recording of Forward Looking Infrared (FLIR) video in the LANTIRN targeting pod that is flown on F-16s, F-15Es, and more recently F-14s. All the imagery and associated support data is stored to a removable 9 Gigabyte magnetic hard disk. The TDRS employs an internal IPEG compression engine that significantly enhances the available record time. The removable disk drive can be easily connected via a SCSI interface to a computer workstation. All the image and support data is stored in MS-DOS file formats, which facilitates easy viewing, evaluation, and distribution of the source data and derived work products. The magnetic disk technology has been successfully used on other military aircraft. It has demonstrated excellent reliability and it has proven to be a cost-effective means of nonvolatile data storage. The use of this technology in the LANTIRN pod is expected to demonstrate the practicality of the TDRS as a dependable, high-quality, affordable, digital image recorder.
Author (AIAA)
Aerial Reconnaissance; FLIR Detectors; Military Aircraft; Magnetic Disks; Tape Recorders

19980057030

F/A-18 multi-spectral tactical reconnaissance

Heinz, Dave, U.S. Navy, Naval Air Systems Command, USA; Demers, P. R., U.S. Navy, Naval Air Warfare Center, USA; Pingsterhaus, Mike, McDonnell Douglas Aerospace, USA; Insinna, Bob, McDonnell Douglas Aerospace, USA; Minor, John, Lockheed Martin Fairchild Systems, USA; Jeffers, Robert H., Hughes Aircraft Co., USA; 1997, pp. 2-16; In English; Copyright; Avail: Aeroplus Dispatch

In order to provide tactical air reconnaissance for the Marines, a reconnaissance variant of the F/A-18D has been introduced to the fleet. This paper provides an overview of the ATARS equipment, radar equipment, and data link equipment aboard this reconnaissance aircraft. The typical reconnaissance mission phases are summarized.
AIAA
F-18 Aircraft; Aerial Reconnaissance; Electro-Optics; Synthetic Aperture Radar; Airborne Radar; Spectral Reconnaissance

19980057031

Flight demonstration of the CA-261 step frame camera

Lareau, Andre G., Recon/Optical, Inc., USA; 1997, pp. 17-28; In English; Copyright; Avail: Aeroplus Dispatch

This paper discusses a recently introduced electro-optical (E-O) step frame camera. The camera is designed for visible-spectrum, medium-altitude, wide-area coverage, military tactical reconnaissance. The paper reviews the tactical reconnaissance requirements for modern E-O cameras mandated by the Joint Chiefs of Staff and Defense Airborne Reconnaissance Office (DARO). Also, camera specifications and major hardware elements are given, followed by camera operational modes and performance. Finally, the paper presents the results of recent demonstration flights, including equipment configuration, flight parameters, and resulting imagery.
Author (AIAA)
Reconnaissance Aircraft; Electro-Optics; Image Motion Compensation; Focal Plane Devices; Cameras

19980057107

Airborne Doppler lidar wind measurement - Housekeeping data as critical parameters

Rahm, Stephan, German Aerospace Research Establishment, Inst. of Optoelectronics, Germany; Nagel, Engelbert, German Aerospace Research Establishment, Inst. of Optoelectronics, Germany; 1997, pp. 163-166; In English; Copyright; Avail: Aeroplus Dispatch

For the airborne measurement of wind fields, exact data on velocity and orientation of the platform are mandatory; small deviations in these parameters will cause a systematic error in the estimation of the wind field. In practice all navigation systems (inertial reference systems and GPS) have some errors in their data which may lead to a significant error in the estimated wind field. However, a conical scanning Doppler lidar such as ADOLAR will also offer some information from the ground return which can be used to select and correct most of the housekeeping data from the other systems. This paper describes briefly the Doppler lidar used for the wind measurements and then extends on the different processing steps necessary to retrieve the 3D wind field with an accuracy better than 1 m/s. The campaign with the airborne Doppler lidar ADOLAR aboard the DLR research aircraft Falcon F20, conducted in November 1996, is used to illustrate this topic. This allows an extended comparison of the different sources of housekeeping data like IRS, GPS, and the Doppler lidar itself.
Author (AIAA)
Airborne Radar; Doppler Effect; Optical Radar; Wind Measurement; Data Processing; Three Dimensional Flow

19980057335

C-130J offers new HUD, improved performance

North, David M., USA; Aviation Week & Space Technology; Dec. 15, 1997; ISSN 0005-2175; Volume 147, no. 24, pp. 56-59, 62; In English; Copyright; Avail: Aeroplus Dispatch

A flight qualities evaluation is presented for the C-130J military transport aircraft, which in addition to more powerful engines incorporates a head-up display to enhance pilot situational awareness. A notable change from earlier versions of the C-130 is a significant reduction in cabin noise. The 3000-mile range of the C-130J without external fuel tanks is comparable to the range of earlier C-130s with the addition of external tanks.

AIAA

Head-Up Displays; Research and Development; C-130 Aircraft; Aircraft Performance

19980057338

Economic, safety gains ignite HUD sales

Proctor, Paul, USA; Aviation Week & Space Technology; Dec. 01, 1997; ISSN 0005-2175; Volume 147, no. 22, pp. 54-57; In English; Copyright; Avail: Aeroplus Dispatch

Airline pilots and operators are almost unanimously enthusiastic about head-up displays (HUDs), discovering secondary benefits that enhance or even outweigh the gains initially anticipated from their use. A key advantage of HUDs is enhanced pilot situational awareness; advanced HUDs with indigenous flight guidance enhance safety by supplying critical clues and performance targets during go-around, wind shear avoidance, and engine-out procedures.

AIAA

Airline Operations; Head-Up Displays; Cockpits

19980057555

FOG AHRS and AHRS/GPS navigation system - The low cost solution for performances

Paturel, Y., SFIM Industries, France; 1997, pp. 12.0-12.13; In English; Copyright; Avail: Aeroplus Dispatch

SFIM Industries has been developing an Attitude and Heading Reference System (AHRS) named APIRS for several years. This AHRS has been qualified and certified for commercial aviation use. APIRS is 'TSOed'. In order to provide additional data, such as velocity and position, the AHRS can be used along with a GPS receiver. SFIM developed such a system. The system has been flown and tested at the French Flight Test Center of Bretigny. This paper describes the system as it has been developed and presents the results which were obtained during the flight trials.

Author (AIAA)

Global Positioning System; Low Cost; Attitude Gyros; Reference Systems

19980057761

An airborne windshear detection system

McLean, D., Southampton, Univ., UK; Zouaoui, Z., Queensland Univ. of Technology, Australia; Aeronautical Journal; Dec. 1997; ISSN 0001-9240; Volume 101,, no. 1010, pp. 447-456; In English; Copyright; Avail: Aeroplus Dispatch

There is growing awareness the danger posed by windshear to aircraft in flight. Statistical evidence is now available which points to the fact that aircraft windshear encounters in initial climb, final approach, or landing are extremely hazardous, often leading to fatal accidents. We present details of a preliminary design for an airborne windshear detection system suitable for use in general aviation aircraft. First, an elementary explanation of windshear and its most dangerous form, the microburst, is given, together with a short account of the hazards that such atmospheric phenomena can present to aircraft in flight, particularly at takeoff and landing. Then a novel windshear detection algorithm is described, and associated simulation results are presented. The algorithm is based on observer theory, and uses only a restricted number of measurements. The system is shown to provide very good estimates of the horizontal and vertical components of some windshear encounters. These estimates of the windshear components are then used to provide the pilot with a warning of the presence of windshear together with an indication of its severity. Digital simulation shows the effectiveness of the proposed design.

Author (AIAA)

Airborne Equipment; Wind Shear; General Aviation Aircraft; Aircraft Accidents; Microbursts (Meteorology); Warning Systems

19980058254

Two dimensional processing for airborne synthetic aperture radar

Cantalloube, Hubert, ONERA, France; Nahum, Carole, ONERA, France; 1997, pp. 152-161; In English; Copyright; Avail: Aeroplus Dispatch

An original method for motion compensation allowing the use of 2D processing for image synthesis is introduced. It provides a more elegant and more efficient solution to range migration and range vs Doppler coupling, compared to the classical range/Doppler processing. We recall and analyze the principle of motion compensation both with range/Doppler processing and with adapted pre-integration. The classical algorithm (specan) uses the variations of distance between the aircraft and a target point in the middle of each focus band in order to compute phase shifts and range migrations. The problem is that the replica is generally not time-invariant when the flight path is not perfectly linear with uniform velocity. Typically, along 1 min of recorded signal, the airplane may deviate transversally from the straight line of some 60 m and longitudinally from a uniform speed of about 25 m. Therefore, the Doppler processing must be performed in the time domain, leading to an increase in computation time with respect to frequency domain processing. Adequate adapted pre-integration may allow the use of 2D processing by (at least on a data block) simulating a linear uniform motion of the center of phase.
Author (AIAA)
Synthetic Aperture Radar; Radar Imagery; Image Processing; Airborne Radar; Image Motion Compensation; Radar Targets

19980058362
Powering the systems
Male, Chris, UK; Aerospace International; Jan. 1998; ISSN 0305-0831; Volume 25, no. 1, pp. 24-27; In English; Copyright; Avail: Aeroplus Dispatch
Some of the issues raised at the 1997 Avionics conference are briefly examined. In particular, attention is given to the rapid increase in the use of electronics in all aircraft systems. The current trend is for the integration of multiple functions in a single component. This process is expected to accelerate over the coming years. The overall aircraft objectives in terms of avionics are defined. Some problems resulting from the increasing use of electrical power on transport aircraft are discussed. Attention is also given to problems associated with the sensitivity of modern computers to cosmic radiation.
AIAA
Turbofan Aircraft; Avionics; Aircraft Design; Power Transmission; Aircraft Production

19980059202
The ER-2 Doppler radar (EDOP) capabilities and performance upgrades
Bidwell, S. W., NASA Goddard Space Flight Center, USA; Heymsfield, G. M., NASA Goddard Space Flight Center, USA; Caylor, I. J., Science Systems and Applications, Inc., USA; 1997, pp. 115, 116; In English; Copyright; Avail: Aeroplus Dispatch
The ER-2 aircraftborne EDOP X-band radar has as its primary objective the study of air motions within convective precipitating regions, from the strong updraft regions to the cirrus anvil regions, in conjunction with active and passive instruments for precipitation and water vapor. Future upgrades to this system will be a nadir-antenna pitch-control algorithm, and a phase-decoding GPS receiver for improved vertical velocity measurements.
AIAA
Doppler Radar; Upgrading; Airborne Radar; Velocity Measurement; Hydrometeorology

19980064139
IMU in-motion alignment without benefit of attitude initialization
Rogers, R. M., Rogers Engineering & Associates, USA; Navigation; 1997; ISSN 0028-1522; Volume 44, no. 3, pp. 301-311; In English; Copyright; Avail: Aeroplus Dispatch
Establishment of local-level wander azimuth navigation and body reference frames for an INS based on outputs of an inertial measurement unit (IMU) without the use of initial attitude information is addressed. These frames are established using a Kalman filter algorithm implemented with an INS system error model formulated for large heading errors and using position measurement updates. Only position and velocity in a geographic reference frame are used for initialization of the INS navigation equations. These data are available from GPS receivers; however, in this paper, an aircraft navigation system's data are used instead to demonstrate the alignment performance based on data from actual flight tests.
Author (AIAA)
Inertial Navigation; Inertial Platforms; Inertial Reference Systems

19980065320
Current status of the NASA/JPL Airborne Synthetic Aperture Radar (AIRSAR)
Lou, Y., JPL, USA; Kim, Y., JPL, USA; Edelstein, W., JPL, USA; Miller, T., JPL, USA; Romero, G., JPL, USA; Sato, T., JPL, USA; Skotnicki, W., JPL, USA; Tauch, S., JPL, USA; 1997, pp. 346-350; In English; Copyright; Avail: Aeroplus Dispatch

The NASA/JPL Airborne Synthetic Aperture Radar system (AIRSAR) has been in operation since 1988. The original radar configuration consisted of P/L/C-band quad-polarization mode in both 20 MHz and 40 MHz chirp bandwidths. Over the years, we have added the L- and C-band along track interferometry mode (ATI), the on-board processor, the C-band cross-track interferometry mode (XTI) in 1991, and the L-band XTI mode in 1995. In addition, we also replaced the GPS receiver as well as the inertial navigation system in 1995 to improve the accuracy of motion compensation and geolocation of the output products. In the 1996 PacRim Campaign, we flew a new digital chirp generator that has significantly better chirp linearity, which should improve the ISLR of the output images. In this paper, we briefly describe the instrument characteristics, the evolution of the various radar modes, the instrument performance, and improvement in the knowledge of the positioning and attitude information of the radar. In addition, we summarize the progress of the data processing effort, especially in the interferometry processing. Finally, we address the issue of processing and calibrating the XTI data.
Author (AIAA)
Airborne Radar; Synthetic Aperture Radar; P Band; C Band

19980065622

Production of large structural titanium castings

Klepeisz, J.; Veeck, S.; JOM; Nov, 1997; ISSN 1047-4838; Volume 49, no. 11, pp. 18-20; In English; Copyright; Avail: Issuing Activity

Titanium-alloy castings have recently become an attractive option for critical-structural applications in aerospace structures. These opportunities have occurred primarily because of the development of advanced-process technologies, such as rapid-prototyping methodology and solidification modeling, which have dramatically reduced the cost and time required to obtain first-article castings through concurrent engineering. Moreover, these technologies have lowered the risk involved in examining new applications for titanium castings. This article examines the implementation of these new technologies and the heat treatment and mechanical properties of large structural castings, particularly in relation to section size. Additionally, the production of a cast-titanium transmission adapter for the V-22 Osprey Tiltrotor aircraft is described.
Author (EI)
Castings; Titanium; Heat Treatment; Aircraft Equipment; Aircraft Parts; Aerospace Engineering; Prototypes

19980066924

Guidance of a roll-only camera for ground observation in wind

Thomasson, P. G., Cranfield Univ., UK; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 39-44; In English; Copyright; Avail: Aeroplus Dispatch

How a nose-mounted imaging sensor with a single-motion axis in roll can be used for ground observation is demonstrated. It is shown that point, line, and area observation are all possible in the presence of wind. Continuous point observation is possible by the use of an orbital trajectory in conjunction with a look-down angle of 90 deg. For other lookdown angles, the trajectories are spirals. Algorithms are derived for aircraft guidance including the cases of arbitrary lookdown angles and stationary or moving ground points, and the effects are illustrated using a six-degree-of-freedom simulation model. The effects of aircraft attitude, wind estimation, and height errors are discussed.
Author (AIAA)
Cameras; Aircraft Instruments; Flight Paths; Roll; Aerial Reconnaissance; Aerial Photography

19980067161

Flight recorders - ICAO to JAR OPS

Moore, Pippa, Civil Aviation Authority, UK; 1997, pp. 1.1-1.15; In English; Copyright; Avail: Aeroplus Dispatch

This paper uses the flight recorder requirements contained in ICAO Annex 6 as a starting point in the definition of the current UK and Joint Aviation Authorities’ documentation on this subject. It is shown how the ICAO standards have been implemented through UK legislation as stated in the Air Navigation Order.
AIAA
Aircraft Accident Investigation; Flight Recorders; Civil Aviation; Flight Safety; Data Recorders; Cockpits

19980067162

Evolution of flight recorder media and protection techniques

Dismukes, Mart, Fairchild Aviation Recorders, USA; 1997, pp. 2.1-2.5; In English; Copyright; Avail: Aeroplus Dispatch

The evolution of recording media used in crash survivable flight data recorders is examined. Oscillographic foil, magnetic wire, metal tape, Mylar tape, and solid state memory are placed in historical perspective with an examination of their properties and suitability. Emphasis is placed on the current solid state medium, with a brief look at the future.
Author (AIAA)
Aircraft Accident Investigation; Flight Recorders; Data Recorders; Metal Foils; Flight Tests

19980067163
Combined CVR and FDR
Malvern, A. R., British Aerospace Systems and Equipment, UK; 1997, pp. 3.1-3.7; In English; Copyright; Avail: Aeroplus Dispatch

The recording of voice and flight data has significantly improved flight safety over many years, so that the carriage of recorders has been mandated for a large range of aircraft for all ICAO states. For large transport aircraft this is normally in the form of two boxes, an FDR (flight data recorder) and a CVR (cockpit voice recorder). There is ever a need for improved safety as the volume of flights increases steadily. This paper discusses the use of combined recorders, which include both the CVR and FDR in a single box, for a range of applications, either to enhance flight safety by dual redundancy or to improve operational efficiency by FOQA (flight operation quality assurance). Applications for military are also discussed, where there is an enthusiasm for COTS.
Author (AIAA)
Aircraft Accident Investigation; Voice Data Processing; Flight Recorders; Cockpits; Data Recorders

19980067275
PtSi, gimbal-based, FLIR for airborne applications
Wallace, J., Israel Aircraft Industries, Ltd., Tamam Div., Yehud, Israel; Ornstein, I., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Nezri, M., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Fryd, Y., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Bloomberg, S., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Beem, S., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Bibi, B., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Hem, S., Israel Aircraft Industries, Ltd., Tamam Div., Yehud; Perna, S., Sarnoff Corp., USA; Tower, J., Sarnoff Corp., USA; 1997, pp. 159-167; In English; Copyright; Avail: Aeroplus Dispatch

A new gimbal-based, FLIR camera for several types of airborne platforms has been developed. The FLIR is based on a PtSi on silicon technology: developed for high volume and minimum cost. The gimbal scans an area of 360 in azimuth and an elevation range of +15 deg to -105 deg. It is stabilized to 25 micro-Rad-rms. A combination of uniformity correction, defect substitution, and compact optics results in a long-range, low-cost FLIR for all low-speed airborne platforms.
Author (AIAA)
Platinum Compounds; Silicon Compounds; FLIR Detectors; Gimbals; Cameras

19980067310
InfraRed Search and Track Technology Demonstrator Programme
Clarke, D. J., GEC-Marconi Sensors, Ltd., UK; Randall, P. N., Defence Research Agency, UK; 1997, pp. 533-543; In English; Copyright; Avail: Aeroplus Dispatch

The objective of the InfraRed Search and Track (IRST) program was to develop a demonstration system capable of long-range detection and tracking of air targets in an airborne environment. This paper describes each of the major subsystems of the IRST equipment, which comprises a pointing and stabilization system, a thermal imaging system, and a signal processing unit. The various modes of operation are outlined which provide the capability to search for, detect, and track multiple targets, to track and display imagery of a selected target, and to provide passive ranging information. A brief discussion of the installation and trials is given. Finally, a discussion of future system capabilities is presented.
Author (AIAA)
Infrared Imagery; Multiple Target Tracking; Signal Processing

19980067600
Open system concepts for modular avionics
Thedens, John R., Rockwell International Corp., Collins Avionics & Communications Div., USA; IEEE Aerospace and Electronic Systems Magazine; Oct. 1997; ISSN 0885-8985; Volume 12,, no. 10, pp. 30-34; In English; Copyright; Avail: Aeroplus Dispatch

The Open Systems Joint Task Force (OS-JTF), formed in September 1994, is chartered to sponsor and accelerate the adoption of open systems in weapons systems and subsystem electronics to reduce life-cycle costs and facilitate effective weapon system

intra- and interoperability. This paper relates the concept of open systems to modular avionics. It discusses the key attributes of an open systems approach and identifies key technologies necessary for its success.
Author (AIAA)
Avionics; Modularity; Systems Engineering; Military Aircraft; Architecture (Computers)

19980067653
JSF affordable avionics study
Groat, J., Honeywell Technology Center, USA; Sawamura, B., Honeywell Technology Center, USA; Spiers, B., Honeywell Technology Center, USA; Driskoll, K., Honeywell Technology Center, USA; Hancock, B., Honeywell Technology Center, USA; Vallot, L., Honeywell Technology Center, USA; Wald, Jerry, Honeywell Technology Center, USA; 1997, pp. 0.3-1 to 0.3-4; In English; Copyright; Avail: Aeroplus Dispatch

The Joint Strike Fighter (JSF) affordable Avionics study evaluates the cost benefits of commercial practices and related technologies for the strike fighter environment. This study addresses the single largest component, avionics, which (including its software) accounts for 25 percent of the system R&D cost and 30 percent of the flyaway cost. We use a variety of system compare-and-contrast techniques and logistic support cost methodologies to assess cost benefits that may accrue to a JSF system from the use of commercial aircraft 'best practices', products and processes. The practices addressed include availability, maintainability, sparing, and mean time between failures cost functions. Using the compare-and-contrast techniques, two specific avionic systems were analyzed: liquid crystal flat-panel displays for cockpits, and ring laser-gyro based inertial navigation systems; their military and commercial versions have similar design heritages, architectures, functions, performance and technology and detailed data bases exist to support the analysis of development, production, and support cost differences. Where logistic support cost analyses were undertaken, JSF life-cycle models are used to indicate operational and support cost savings through the use of commercial products and practices.
Author (AIAA)
Fighter Aircraft; Avionics; Display Devices; Liquid Crystals; F-16 Aircraft; Inertial Navigation

19980067655
The Flight 2000 avionics suite - The way to free flight
Kirkman, Deborah A., MITRE Corp., USA; Tuttle, David B., FAA, USA; 1997, pp. 0.5-1 to 0.5-6; In English; Copyright; Avail: Aeroplus Dispatch

The FAA's Flight 2000 project is an innovative initiative to implement and validate selected operational improvements leading to 'Free Flight'; it integrates new avionics, new ground systems, new procedures, avionics certification, and operational approval. Approximately 2000 aircraft operating in Alaska, Hawaii, and Oceanic airspace will be equipped with new capabilities, enabling benefits such as improved situational awareness, increased flexibility, and efficiency gains. by developing and fielding these operational improvements, the actual benefits of new procedures and capabilities will be validated, and risks associated with national implementation will be reduced.
Author (AIAA)
Avionics; Free Flight

19980067665
A performance study of the concurrency control algorithms for real-time avionics databases
Peng, Ching-Shan, California, Univ., Irvine, USA; Lin, Kwei-Jay, California, Univ., Irvine; 1997, pp. 1.2-23 to 1.2-30; In English; Copyright; Avail: Aeroplus Dispatch

Providing timely situation awareness to the human operator is a critical function of software-intensive combat systems such as avionics systems. The real-time database (RTDB) management system is a key enabling technology to make the required information available for effective decision making in mission-critical situations. The database that represents a rapidly evolving tactical environment must provide for considering the age of data and the predictability of data access, as well as traditional data integrity constraints. We discuss applying a novel concurrency control protocol that addresses the realtime issues of data timeliness and predictable performance within the framework of a RTDB management system. The performance of the concurrency control approach is studied by simulations.
Author (AIAA)
Concurrent Engineering; Real Time Operation; Avionics; Data Bases; Management Systems

19980067686

Controlled flight into terrain and the enhanced ground proximity warning system

Bren, Barry C., AlliedSignal Commercial Avionics System, USA; 1997, pp. 3.1-1 to 3.1-7; In English; Copyright; Avail: Aeroplus Dispatch

The leading cause of world wide aviation fatalities comes from inadvertently flying a perfectly operating aircraft into the ground or water. This type of accident is referred to as Controlled Flight Into Terrain (CFIT). Statistics show that introduction of the Ground Proximity Warning System (GPWS) into the scheduled air carrier turbojet fleet has been accompanied by dramatic drop in the frequency of CFIT accidents. Training aids, videos, checklists, and procedural recommendations have also been produced to aid in CFIT risk reduction. Despite these actions, CFIT worldwide losses continue. Common characteristics of these continued accidents are lack of installed GPWS or shortcomings of current GPWS detection algorithms. The Enhanced GPWSs have been developed to address these shortcomings, and to provide enhanced situational awareness to the pilots such that CFIT accidents can become a thing of the past.

Author (AIAA)

Flight Control; Warning Systems; Aircraft Approach Spacing

19980067687

The next step toward enhanced situational awareness

Ulbrich, Erv, McDonnell Douglas Aerospace, USA; 1997, pp. 3.1-8 to 3.1-20; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the author's view of the next step in aircraft cockpit situational awareness. In this concept, all of the existing and planned products of avionics research are integrated into a coherent set of visual displays and aural signals for use by the pilots. This results in a set of 64 display formats addressed by 8 x 8 Bezel buttons and 6 aural formats automatically addressed by the urgency of the situation. Some of the formats are in pseudo-3D. The aural signals include spatial content. Early examples will be shown of the integration and the formats.

Author (AIAA)

Cockpits

19980067688

Boeing 777 airplane information management system operational experience

Aleksa, Brian D., Honeywell, Inc., USA; Carter, Joseph P., Honeywell, Inc., USA; 1997, pp. 3.1-21 to 3.1-27; In English; Copyright; Avail: Aeroplus Dispatch

The Aircraft Information Management System (AIMS) on the Boeing 777 is one of the first applications of modular avionics to commercial aircraft. This paper discussed AIMS system design goals and objectives, and reviews the resulting system design and operation including capabilities and features. The results of the first two years of operation are compared with these goals and objectives. Also described are some of the important lessons learned during system development and initial airline operation.

Author (AIAA)

Boeing 777 Aircraft; Avionics; Commercial Aircraft; Information Management

19980067690

MEMs application in tactical aircraft systems

Stafford, Edward L., III, Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 3.1-37 to 3.1-41; In English; Copyright; Avail: Aeroplus Dispatch

MicroElectroMechanical Systems (MEMS) have unrealized potential for improving aircraft capability and affordability. This technology, which leverages the highly automated production processes used by the semiconductor industry, can achieve reductions in the cost, size, and weight of integrated electrical and mechanical devices. Typical commercial examples are manifold air pressure sensors, airbag accelerometers, and ink-jet-printer heads. Demand from the automotive, medical, and computer industries has helped to mature some of the commercial applications, but tactical aircraft applications have been hindered by the lack of practical MEMS knowledge by aircraft design engineers, appropriate designs for distributed power and communications, and cost-effective, low production volume fabrication. These and other problems were investigated during a probe into the use of MEMS for three tactical aircraft-related applications.

Author (AIAA)

Aircraft Design; Aircraft Performance

19980067691

Avionics architecture study for Air Mobility Command aircraft

White, B. E., MITRE Corp., USA; 1997, pp. 3.2-1 to 3.2-7; In English; Copyright; Avail: Aeroplus Dispatch

New standards for air traffic management (ATM) are being developed within official aeronautical organizations throughout the world. The USAF Air Mobility Command (AMC) is planning for new avionics or avionics upgrades to ensure its aircraft have airspace access worldwide. AMC tasked the air traffic control and landing systems (ATCALS) system program office of the Air Force Electronic Systems Center (ESC) at Hanscom AFB to investigate avionics architectures for equipping AMC aircraft. This paper summarizes that study, which was performed by ESC and MITRE Corporation staff under the ATCALS project.

Author (AIAA)

Avionics; Military Aircraft

19980067692

Phenomenology of integrated avionics and the currently fielded aircraft market

Minges, Mark, USAF, Wright Lab., USA; 1997, pp. 3.2-8 to 3.2-14; In English; Copyright; Avail: Aeroplus Dispatch

The USAF has made a significant investment in Integrated Modular Avionics (IMA) over the past 15 years, with the only real application of a totally integrated avionics suite in the F-22. The next new tactical platform, the Joint Strike Fighter, will also employ integrated avionics leveraging off of the F-22. It is time to ask whether currently fielded aircraft can leverage the USAF investment in integrated avionics to meet the requirements of weapon system deficiencies, function upgrades, and modernization. A cost/benefit analysis was performed the USAF with participation from the Navy, comparing a federated or a 'black box' approach to an integrated avionics suite, in the area of Communications, Navigation, and Identification (CNI) for a specific set of waveforms/requirements. The integrated CNI system used in the analysis was based on portions of the F-22's integrated avionics suite. Several phenomena surfaced when trying to fit IMA systems into today's tactical weapon systems and the current federated way of thinking.

Author (AIAA)

Phenomenology; Systems Integration; Avionics; Fighter Aircraft; Modularity; Cost Analysis

19980067693

Incremental avionics upgrades for legacy aircraft

Nelson, James, Northrop Grumman Corp., USA; 1997, pp. 3.2-15 to 3.2-23; In English; Copyright; Avail: Aeroplus Dispatch

Northrop Grumman, with major roles as both a prime aircraft systems manufacturer and a major digital electronics subsystem supplier and integrator, is actively developing technologies and processes to support legacy aircraft upgrades. Our fielded systems include proven platforms such as the A-10, F-5, EA-6, F-14, and B-2. These aircraft incorporate diverse avionics architectures and subsystems necessitated by varying requirements and technologies available to the original system designers. The diversity in form, fit and function of individual subsystems of these, and other legacy aircraft lends itself to an incremental upgrade methodology. Commercial digital technologies have improved performance by orders of magnitude over the past decade. Advanced data and signal processing and networking capabilities present opportunities for extending the life expectancy of our existing military aircraft to meet new mission requirements. An overall systems engineering approach is required using open architectures; this considers not only immediate upgrade requirements, but also allows for changes to one part of the system without affecting the other parts. Also, these changes can be done incrementally, spaced over a period of time as requirements and budget realities allow.

Author (AIAA)

Service Life; Cost Reduction

19980067694

Structured definition of modular avionics architectures using blueprints

Marchetto, A., Alenia Aeronautica, Italy; 1997, pp. 3.2-24 to 3.2-31; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports the outcome of research activities in the field of modeling/simulation of advanced avionics architectures. International research programs encompassing integrated modular avionics have indicated a layered software architecture as the means to fulfill important requirements, such as software portability, software reusability and system fault tolerance. One of these layers, the System Applications Layer, is in charge of managing the system in order to provide a behavior which, across the various mission phases and system states, is compliant to what is required by a structured description, realized off-line and embodied in a set of 'blueprints' accessible by the System Manager in real-time. This paper develops the blueprints concept, carrying out an exercise of its application to a reference system architecture.

Author (AIAA)

Avionics; Modularity; Blueprints

19980067703

Electromagnetic susceptibility of installed avionics

Devereux, R. W., Veda, Inc., USA; Fuller, Gerald L., Veda, Inc., USA; Schillinger, Ray, FAA, Technical Center, USA; 1997, pp. 4.1-17 to 4.1-24; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports on research and experimental results of commercial aircraft avionics and control systems exposed to conducted and radiated EMI. Several experiments were conducted on modern avionics certified to High Intensity Radiated Fields standards while installed in the FAA’s CV-580 research aircraft. This research used RF sources and probes aboard the aircraft to evaluate installed avionics susceptibility thresholds. The effects of this on-board RF interference to primary systems operations was examined under various operational scenarios during several different experiments. Mode stirring of the aircraft’s cavity was used to allow accurate estimation of the upper bounds of system susceptibility. Experiments determined how susceptible installed avionics are to different low power RF sources located in passenger cabin and baggage compartments, and avionics and cargo bay areas.

Author (AIAA)

Electromagnetic Interference; Avionics; Commercial Aircraft; Research Aircraft; Radio Frequencies

19980067705

Open-loop HIRF experiments performed on a fault tolerant flight control computer

Koppen, Daniel M., NASA Langley Research Center, USA; 1997, pp. 4.1-33 to 4.1-39; In English; Copyright; Avail: Aeroplus Dispatch

During the third quarter of 1996, the Closed-Loop Systems Laboratory was established at NASA-Langley to study the effects of High Intensity Radiated Fields (HIRF) on complex avionic systems and control system components. This new facility provided a link and expanded upon the existing capabilities of the HIRF Laboratory at NASA-Langley that were constructed and certified during 1995-96. The scope of the Closed-Loop Systems Laboratory is to place highly integrated avionics instrumentation into a high intensity radiated field environment, interface the avionics to a real-time flight simulation that incorporates aircraft dynamics, engines, sensors, actuators and atmospheric turbulence, and collect, analyze, and model aircraft performance. This paper describes the layout and functionality of the Closed-Loop Systems Laboratory, and the open-loop calibration experiments that led up to the commencement of closed-loop real-time flight experiments.

Author (AIAA)

Fault Tolerance; Flight Control; Numerical Control; Airborne/Spaceborne Computers; Electromagnetic Radiation

19980067715

Fiber optic backplane for reducing HIRF effects in fault tolerant computing platforms

Malekpour, Mahyar, NASA Langley Research Center, USA; 1997, pp. 4.3-25 to 4.3-33; In English; Copyright; Avail: Aeroplus Dispatch

The design and development of a fault-tolerant fiber-optic backplane to reduce the effects of electromagnetic environments on flight-critical computing platforms is presented. The backplane was developed at NASA-Langley, and is currently undergoing analysis, simulation, and tests. The simulation results of tests on the backplane in the advent of simulated high intensity radiated fields (HIRF) induced faults are presented, and the fault recovery capability of the architecture is demonstrated. The architecture was designed, developed, and implemented using the Very High Speed Integrated Circuits Hardware Description Language. The architecture was synthesized and implemented in hardware using field programmable gate arrays on multiple PC boards.

Author (AIAA)

Fiber Optics; Fault Tolerance; Electromagnetic Radiation; Computerized Simulation

19980067718

Data analysis system for the F-16

Atkinson, G. F., Lockheed Martin Tactical Aircraft Systems, USA; Austin, S. C., Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 4.5-1 to 4.5-5; In English; Copyright; Avail: Aeroplus Dispatch

The use of desktop tools to retrieve and analyze flight test data has significantly increased the efficiency of these tasks during F-16 avionics systems flight testing. Technological advances have also enabled engineering staff members to retrieve and analyze large amounts of recorded test data in hours instead of the days or weeks that have been required in the recent past. These enabling technological advances include the miniaturization of test aircraft instrumentation systems, the use of small, yet common, recording media, the rapid advancements of office computer systems, and the availability and ease of use of analysis software. These advancements, added together, provide the ability to start the analysis of collected flight test data within moments of the aircraft landing, and gives the engineer all of the tools to accomplish this analysis at his fingertips, without the need to wait for data service

requests to be filled by a second party. Data can be gathered from the system as needed. Standing data reports for each flight are no longer necessary; only the required data is gathered. The entire data analysis system is assembled from commercially available, off-the-shelf components, at reasonable cost.
Author (AIAA)
F-16 Aircraft; Avionics; Flight Tests; Microcomputers; Data Management; Data Retrieval

19980067722

An open system architecture for integrated RF systems

Brousseau, Ray, Lockheed Martin Co., USA; Huffman, Dean R., Northrop Grumman Corp., USA; Abercrombie, Hal, Rockwell International Corp., Collins Avionics & Communications Div., USA; Hoffman, Dennis L., Rockwell International Corp., Collins Avionics & Communications Div., USA; Coleman, Spencer, Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 5.1-1 to 5.1-6; In English; Copyright; Avail: Aeroplus Dispatch

The PAVE PACE program showed that the cost and weight of an avionics system for a new aircraft can be cut in half, and its reliability tripled, by incorporating the concepts of common modules, resource sharing, and reconfiguration into the sensor domain. The sensor domain includes the classical communication-navigation-identification, radar, and electronic warfare suite. The Integrated Sensor System (ISS) program is a concept development and validation initiative to address the RF avionics affordability. The ISS goal is to define an Open System Architecture (OSA) based on a 2001 Technology Availability Date (TAD) which provides economies of scale through wide-spread application, decreased number of unique module types, increased competition, and increased leverage of commercial off-the-shelf-based hardware and software. Architecture validation is achieved through a series of builds and demonstrations using the open system standards. This paper describes the integrated RF sensor OSA for a 2001 TAD, how the architecture standards are being implemented using 1997 technologies, and the lessons learned to date.
Author (AIAA)
Systems Integration; Avionics; Radio Frequencies; Electronic Warfare; Fighter Aircraft

19980067723

Electro-optical sensors overview

Crawford, F. I., Hughes Aircraft Co., USA; 1997, pp. 5.1-7 to 5.1-14; In English; Copyright; Avail: Aeroplus Dispatch

Over the past 30 years, IR imaging sensors have become smaller and more sensitive. Modem IR sensors produce high-resolution, direct TV-compatible video in total darkness or inclement weather conditions. The state-of-the-art in these technologies is surveyed, giving attention to Forward-Looking IR sensors.
Author (AIAA)
Electro-Optics; Sensors; Infrared Imagery

19980067725

Passive millimeter wave imaging sensor enhanced vision system

Ortiz, Alberto, Boeing Co., USA; 1997, pp. 5.1-23 to 5.1-30; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the concept and development activities for a Passive Millimeter Wave Imaging Sensor System that offers significant safety benefits to world aviation. Made possible by recent technological breakthroughs, Passive Millimeter Wave (PMMW) imaging sensors provide visual-like images of objects within their fields of view even under low visibility conditions (e.g., fog, clouds, snow, sandstorms, and smoke) that would blind visual and IR sensors. Unlike synthetic images (computer generated), the PMMW image is real and completely passive, thus providing numerous advantages over competing technologies. The Boeing Company is member of a consortium developing an advanced, demonstrator version of a PMMW imaging sensor, identified as a 'camera', that, when front-mounted on an aircraft, will give images of the forward scene at a rate and quality sufficient to enhance aircrew vision and situational awareness under low visibility conditions. The consortium will begin a flight demonstration program with the demonstration PMMW camera in 1997. We describe the characteristics of a PMMW image in a system baseline integrated with other flight avionics to form an Enhanced or Synthetic Vision System.
Author (AIAA)
Millimeter Waves; Microwave Imagery; Vision; Traffic Control; Aircraft Landing

19980067728

Scalable Open Architecture Project (SOAP) avionics evolution from federated to open systems

Ozols, Juris, Computing Devices International, USA; 1997, pp. 5.2-10 to 5.2-17; In English; Copyright; Avail: Aeroplus Dispatch

The Scalable Open Architecture Project (SOAP) of NAVAIR's Maritime Avionics Subsystems and Technologies Program was established in 1996 to demonstrate how to evolve existing aircraft from federated to advanced scalable open systems through

incremental system upgrades, making maximum use of commercial off-the-shelf (COTS) technology. This project is a multiyear effort with a series of laboratory demonstrations that transform existing federated avionics architectures into a scalable open architecture embodying a unified interconnect concept based on a Fiber Channel network. Architectural changes (e.g., network, processor, and software) that are being addressed include insertion and evaluation of avionics functions with high operational payoff. This paper documents the results of the first year's efforts and demonstrations, and describes on-going activities and plans. The required architectural evolution is clearly feasible, and use of COTS components, both hardware and software, is attractive and potentially fully applicable.
Author (AIAA)
Avionics

19980067756

Cockpit Weather Information (CWIN) System

Tu, Jeffrey C., Boeing Co., USA; 1997, pp. 7.1-1 to 7.1-4; In English; Copyright; Avail: Aeroplus Dispatch

The objective of this advanced concept, Cockpit Weather Information System (CWIN), is to develop an aeronautical system that delivers real-time graphical weather information with global-coverage to the flight deck of an aircraft via a satellite communications system (SATCOM)/GPS. Pilots today have difficulties obtaining weather information in-flight in a timely manner allowing for accurate trend information and weather avoidance. These problems result in incomplete weather situation awareness, difficulty making strategic re-route decisions, and consequently, close encounters with adverse weather. Furthermore, inadequate dissemination capability of fixed weather stations has always been a concern to the USAF and commercial operators. Inadequate and unreliable deployable weather equipment often fails to disseminate information quickly and effectively to pilots. Consequently, mission success probability is affected by this deficiency. The CWIN system offers an opportunity to develop a cockpit graphical weather system for in-flight pilot utilization in meeting the demands of today's operational requirements.
Author (AIAA)
Cockpits; Weather Forecasting; Real Time Operation

19980067758

A portable lightweight associate for urban helicopter pilotage

Geddes, N. D., Applied Systems Intelligence, Inc., USA; Lee, R. J., Applied Systems Intelligence, Inc., USA; Brown, J. L., Applied Systems Intelligence, Inc., USA; 1997, pp. 7.1-11 to 7.1-18; In English; Copyright; Avail: Aeroplus Dispatch

The Urban Helicopter Associate System (UHAS) is an advanced demonstration prototype of an associate system for aiding pilots of rotorcraft engaged in complex missions in urban environments. It is the first of a evolving class of lightweight associate systems that provide full associate decision aiding in a lightweight computing environment. The UHAS is hosted on a laptop computer, and is intended for limited flight demonstrations in law enforcement and emergency medical services scenarios.
Author (AIAA)
Portable Equipment; Cities; Navigation Aids; Microprocessors; Helicopters

19980067760

A flat panel display upgrade solution replaces military CRT technology

Coker, Byron L., Jr., Georgia Inst. of Technology, Atlanta, USA; Willis, Michael J., Georgia Inst. of Technology, Atlanta; 1997, pp. 7.1-26 to 7.1-31; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a technology insertion program undertaken at the Georgia Tech Research Institute to replace the 30-year-old azimuth indicator display of a radar warning receiver system. This necessitated the use of electroluminescent (EL) display technology to replace the analog cathode ray tube display currently used in the system. Because of the prohibitively high cost of aircraft wiring modifications, the replacement display was required to be completely form, fit, and functionally equivalent to its replacement. The form, fit, and functional equivalency requirement imposed the following system constraints: power consumption of less than 10 W; the need to maintain the same stroke-deflection current electrical interface; and the need to meet the maintenance and repair budget of the existing display unit. Additional requirements included night-vision compatibility and full sunlight readability. The display was also required to be MIL-STD-1553 Remote Terminal communication capable. The case study described in this paper illustrates the approach to meeting the particular requirements of this technology insertion program.
Author (AIAA)
Flat Panel Displays; Cathode Ray Tubes; Military Technology; Avionics

19980067761

An overview of the VITAL program

Hodges, Dave, Boeing Co., USA; 1997, pp. 7.2-1 to 7.2-7; In English; Copyright; Avail: Aeroplus Dispatch

VITAL (Vehicle Management System Integration Technology for Affordable Life Cycle Cost) is a DARPA Technology Reinvestment Project (TRP) with the objective of reducing the life-cycle cost of vehicle management systems by 50 percent with respect to current systems. The approach is to develop an open architecture with common hardware and software building blocks based on commercial parts and practices. The approach will be applicable to a wide variety of platforms, including fixed wing fighter aircraft, helicopters, and transport aircraft. Software development using MATRIX is a significant process improvement being exploited in the VITAL program to reduce nonrecurring costs. Verification of the VITAL approach will occur in three flight demonstrations on an F/A-18, an AH-64 and an MD-90. VITAL is a three-year effort that began in mid-1996. Milestone 2 (initial design review) was completed in August 1997.

Author (AIAA)

Life Cycle Costs; Management Systems; Fighter Aircraft; Helicopters; Transport Aircraft; Aircraft Design

19980068571

Advanced Radiometric Millimeter-Wave Scene Simulation ARMSS

Hauss, B. I., TRW Space and Electronics Group, USA; Agravante, H., TRW Space and Electronics Group, USA; Chaiken, S., TRW Space and Electronics Group, USA; 1997, pp. 182-193; In English

Contract(s)/Grant(s): NCC1-196; Copyright; Avail: Aeroplus Dispatch

In order to predict the performance of a passive millimeter wave sensor under a variety of weather, terrain, and sensor operational conditions, TRW has developed the Advanced Radiometric Millimeter-Wave Scene Simulation (ARMSS) code. This code provides a comprehensive, end-to-end scene simulation capability based on rigorous, 'first-principles' physics models of the passive millimeter wave phenomenology and sensor characteristics. The ARMSS code has been extensively benchmarked against both data in the literature and a wide array of millimeter-wave field-imaging data. The code has been used in support of numerous passive millimeter wave technology programs for interpreting millimeter wave data, establishing scene signatures, performing mission analyses, and developing system requirements for the design of millimeter wave sensor systems. In this paper, we present details of the ARMSS code and describe its current use in defining system requirements for the passive millimeter wave camera being developed under the Passive Millimeter Wave Camera Consortium led by TRW.

Author (AIAA)

Microwave Radiometers; Millimeter Waves; Scene Analysis

19980068637

More advances in real-time millimeter-wave imaging radiometers for avionic synthetic vision

Chou, Ri-Chee, ThermoTrex Corp., USA; Lovberg, John, ThermoTrex Corp., USA; Martin, Chris, ThermoTrex Corp., USA; 1997, pp. 2-7; In English

Contract(s)/Grant(s): DAAL02-92-C-0057; DAAL01-94-C-0100; Copyright; Avail: Aeroplus Dispatch

Mm-wave thermal imaging provides a unique autonomous capability for aircraft landing in adverse weather, giving a pilot a comprehensive view of runway location and availability in real time, with high fidelity. ThermoTrex Corporation has reported previous results from a Passive Millimeter-wave Camera demonstration device. The addition of W-band low-noise amplifiers to the front end of this sparse phased-array thermal imaging camera has improved system thermal sensitivity by 5 dB over that previously reported. Processing upgrades have increased system frame update rate to about 1 Hz, and remote site field testing has established phenomenology relevant to aircraft landing guidance applications. Next-generation hardware design has addressed the issue of aircraft integration using an innovative lightweight, X-band antenna for 89 GHz thermal imaging. A flightworthy demonstration imager using this antenna is currently under construction for 10 Hz operation.

Author (AIAA)

Computer Vision; Avionics; Millimeter Waves; Real Time Operation; Landing Aids; Microwave Imagery

19980068638

The HiVision mm-wave radar for enhanced vision systems in civil and military transport aircraft

Pirkl, Martin, Daimler-Benz Aerospace AG, Germany; Tospann, F. J., Daimler-Benz Aerospace AG, Germany; 1997, pp. 8-18; In English; Copyright; Avail: Aeroplus Dispatch

Guidelines for meeting the requirements of forward looking sensors of an Enhanced Vision System (EVS) for both military and civil transport aircraft are presented. For civil transport aircraft, an imaging mm-wave radar is proposed as the vision sensor. For military air transport, an additional high-performance weather radar should be combined with the mm-wave radar to enable

advanced situational awareness, e.g. spot-SAR or air-to-air operation. For tactical navigation (e.g. low level flight operations and real-time correlation with electronic maps), the mm-wave radar is useful due to its ranging capabilities. To meet these requirements the HiVision radar was developed and tested; it uses a robust concept of electronic beam steering and will meet the strict EVS price constraints of transport aircraft. Advanced image processing and HF techniques are being developed to enhance the performance of both the radar image and integration techniques. The advantageous FMCW waveform enables an EVS with low probability of intercept and a high resistance against jammer to be obtained.
Author (AIAA)
Millimeter Waves; Transport Aircraft; Computer Vision; Imaging Radar

19980068642

A method for detecting and avoiding flight hazards

von Viebahn, Harro, VDO Luftfahrtgeraete Werk GmbH, Germany; Schiefele, Jens, Darmstadt, Technische Univ., Germany; 1997, pp. 50-56; In English; Copyright; Avail: Aeroplus Dispatch

Today's aircraft equipment comprise several independent warning and hazard avoidance systems like GPWS, TCAS or weather radar; the pilot's task is to monitor all these systems and take the appropriate action in case of an emerging hazardous situation. The present method for detecting and avoiding flight hazards combines all potential external threats for an aircraft into a single system. It is based on an aircraft-surrounding airspace model consisting of discrete volume elements. For each element of the volume, the threat probability is derived or computed from sensor output, databases, or information provided via datalink. The position of the aircraft is predicted by using a probability distribution. This approach ensures that all potential positions of the aircraft within the near future are considered while weighting the most likely flight path. A conflict-detection algorithm initiates an alarm in case the threat probability exceeds a threshold. An escape maneuver is generated taking into account all potential hazards in the vicinity, not only the one which caused the alarm. The algorithm was implemented and tested in a flight simulator environment. The current version comprises traffic, terrain and obstacle hazards-avoidance functions.
Author (AIAA)
Flight Hazards; Warning Systems; Collision Avoidance; Flight Safety

19980068643

Affordable MMW aircraft collision avoidance system

Almsted, Larry D., Honeywell Military Avionics, USA; Becker, Robert C., Honeywell Technology Center, USA; Zelenka, Richard E., NASA Ames Research Center, USA; 1997, pp. 57-63; In English; Copyright; Avail: Aeroplus Dispatch

A low cost, dual-function, scanning pencil-beam, mm-wave (MMW) radar forward sensor is used to determine whether an aircraft's flight path is clear of obstructions. Due to the limited space and weight budget in helicopters, the system is a dual-function system that is substituted in place of the existing radar altimeter. The system combines a 35 GHz forward-looking obstacle avoidance radar and a 4.3 GHz radar altimeter. The forward-looking 35 GHz 3D radar's returns are used to construct a terrain and obstruction database surrounding an aircraft, which is presented to the pilot as a synthetic perspective display. The 35 GHz forward-looking radar and the associated display were evaluated in a joint NASA Honeywell flight test program in 1996. The tests were conducted on a NASA/Army test helicopter. The test program clearly demonstrated the system's potential usefulness for collision avoidance.
Author (AIAA)
Collision Avoidance; Cost Reduction; Millimeter Waves; Helicopters

19980068644

Simulation of imaging radar for obstacle avoidance and enhanced vision

Doehler, Hans-Ulrich, German Aerospace Research Establishment, Inst. of Flight Guidance, Germany; Bollmeyer, Dirk, German Aerospace Research Establishment, Inst. of Flight Guidance, Germany; 1997, pp. 64-72; In English; Copyright; Avail: Aeroplus Dispatch

One of the main advantages of mm-wave (MMW) imaging radar systems results from the fact that their imaging performance does not substantially depend on atmospheric effects such as fog, rain, and snow. That is the reason that MMW radar seems to be one of the most promising sensors for enhanced vision systems (EVS) which can aid the pilot during approach, landing and taxiing, especially under bad weather conditions. We have developed a new type of a MMW radar sensor simulator. Our approach is based on detailed terrain and/or airport data bases, augmented with some specific attributes which describe object surface properties with respect to MMW. Our approach benefits from the state of the art of high speed computer graphics hardware and software. It is implemented in C/C++ and uses the OpenGL graphic standard and the SGI Performer data base handler. The system runs on every SGI graphic workstation, and achieves an image update rate of about 20 Hz, which is more than current radar systems

deliver. One of the main advantages of our approach is that it can be integrated easily in emergent multisensor-based enhanced vision systems.
Author (AIAA)
Imaging Radar; Collision Avoidance; Systems Simulation; Computer Vision; Image Processing

19980068645

Flight tests of the 4D flight guidance display

Below, Chritian, VDO Luftfahrtgeraete Werk GmbH, Germany; von Viebahn, Harro, VDO Luftfahrtgeraete Werk GmbH, Germany; Purpus, Matthias, Darmstadt, Technische Univ., Germany; 1997, pp. 74-80; In English; Copyright; Avail: Aeroplus Dispatch

A perspective primary flight and navigation-display format (NDF) were evaluated in a flying testbed. The flight tests comprised ILS and standard approaches as well as low level operations, using the depiction of a spatial channel, and demonstrations of the inherent ground proximity warning function. In the cockpit of the VFW614 aircraft, the left seat was equipped with a sidestick and a flat-panel display, which showed both the 4D-display and the NDF. Airline and military pilots flew several missions each; while they could follow the channel precisely, some airline pilots stated a lack of vertical guidance information during the final approach. Leaving and reentering the channel could be easily accomplished from any direction. It was stated that displays are an appropriate means to avoid controlled flight into terrain accidents.
Author (AIAA)
Flight Tests; Aircraft Guidance; Display Devices

19980068647

Data collection system for Autonomous Landing Guidance

Tiana, Varlo L. M., FLIR Systems, Inc., USA; Pond, Duane, FLIR Systems, Inc., USA; 1997, pp. 88-98; In English; Copyright; Avail: Aeroplus Dispatch

We describe a sophisticated system for the collection of numerous streams of image and aircraft state data from an airborne platform. The system collects and stores (for later analysis) seven different sources of analog video data; three separate sources of digital video data (at aggregate rates of up 32 Mbytes/sec) to a removable tape device of 100 Gbytes (50 min capacity); and low-bandwidth aircraft state information from inertial sources. Data from all sources are time-stamped with a common (GPS-derived) time source for synchronization. The task of accurately time-stamping multiple disparate data sources is a challenging one, and is discussed in some detail. Although the technology that can be applied to this kind of effort advances and changes rapidly, certain design paradigms remain valid independent of the specific implementation hardware. General principles of design and operation, as well as system specifics, are described.
Author (AIAA)
Data Acquisition; Landing Aids; Autonomous Navigation; Aircraft Landing

19980068650

Computer vision sensor for autonomous helicopter hover stabilization

Oertel, Carl-Henrik, DLR, Inst. fuer Flugmechanik, Germany; 1997, pp. 121-129; In English; Copyright; Avail: Aeroplus Dispatch

A computer-vision based system able to observe helicopter flight state during hover and low speed flight, based on the detection and tracking of significant but arbitrary features, has been developed. A CCD camera looks straight downward to the ground and produces an image of the ground view. The digitized video signal is fed into a high performance on-board computer which looks for distinctive features in the image. Any motion of the helicopter results in movements of these patterns in the camera image. by tracking the distinctive features during the succession of incoming images and by the support of inertial sensor data, it is possible to calculate all necessary helicopter state variables, which are needed for a position hold control algorithm. This information is gained from a state variable observer; no additional information about the appearance of the camera view has to be known in advance to achieve autonomous helicopter hover stabilization. Feature tracking is performed by a dedicated 2D-correlator subsystem.
Author (AIAA)
Computer Vision; Helicopter Control; Hovering; Aircraft Stability; Automatic Flight Control

19980068651

Enhanced vision - Flight test and performance measurement

Balon, Kevin G., Maryland Advanced Development Lab., Greenbelt, USA; Connor, Sidney A., Maryland Advanced Development Lab., Greenbelt; 1997, pp. 130-140; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a flight test methodology and performance measurement system for evaluation of Enhanced Vision Systems (EVS). The architecture for the performance measurement system used on a low operating cost Cessna 402 EVS flight test aircraft, and on the DARPA Autonomous Landing Guidance Boeing 727 flight test aircraft, is described. Data collection and analysis system is presented in the context of civil aviation requirements. A summary of the flight test accomplishments with the performance measurement system to date is also presented.

Author (AIAA)

Computer Vision; Flight Tests; Autonomous Navigation; Landing Aids; Aircraft Landing

19980068654

Model-based sensor fusion for aviation

Pavel, Misha, Oregon Graduate Inst. of Science and Technology, Portland, USA; Sharma, Ravi K., Oregon Graduate Inst. of Science and Technology, Portland; 1997, pp. 169-175; In English

Contract(s)/Grant(s): NCC2-811; Copyright; Avail: Aeroplus Dispatch

We describe a sensor fusion algorithm based on a set of simple assumptions about the relationship among the sensors. Under these assumptions we estimate the common signal in each sensor, and the optimal fusion is then approximated by a weighted sum of the common component in each sensor output at each pixel. We then examine a variety of techniques to map the sensor signals onto perceptual dimensions (e.g., color), such that the human operator can benefit from the enhanced fused image and simultaneously be able to identify the source of the information. We examine several color-mapping schemes.

Author (AIAA)

Multisensor Fusion; Algorithms; Aircraft Guidance

19980068743

An intelligent failure diagnostic instrument for an airborne automatic cannon

Zen, Zhenhua, Air Force, First Aeronautical Inst., China; Cha, Guoyun, Air Force, First Aeronautical Inst., China; Shen, Weizhong, Air Force, First Aeronautical Inst., China; Xu, Guoqiang, Air Force, First Aeronautical Inst., China; Pan, Maoqing, Air Force, First Aeronautical Inst., China; 1997, pp. 489-493; In English; Copyright; Avail: Aeroplus Dispatch

This paper introduces a method for defining the standard value, failure values, and operational processing of testing, as well as judging the testing result in an intelligent failure diagnostic instrument for an airborne automatic cannon. A mathematical model for the cannon is developed, and how the cannon's mobility curve is translated into an electrical signal and transferred to a microcomputer as a standard signal is described. Finally, it is shown how the partial motion signals of the cannon are sensed during cannon operation and compared with the standard signal to detect and analyze failures.

AIAA

Failure Analysis; Guns (Ordnance); Airborne Equipment

19980071419

Integrated modular avionics ***L'avionique modulaire integree***

Loise, Dominique, Sextant Avionique, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Feb. 1997; ISSN 1247-5793, no. 1, pp. 48-52; In French; Copyright; Avail: Aeroplus Dispatch

The world of avionics is changing, and the rate of change is going to increase. Current avionics consists in a collection of independent subsystems specifically designed for an aircraft. The embedded functions tend to be more sophisticated, especially on military aircraft, while the equipment becomes an important part in terms of weight, size, power consumption, and cost of the aircraft. Today, the major challenge is cost reduction, due to the aggressive competition between the aircraft manufacturers or the airlines and the budget reduction of air forces; at the same time, the performance functions are increasing. to overcome these problems, the aeronautical community defined, in the late 1970s and early 1980s, generic avionics based on a limited number of small units and concepts to allow the reuse of their functions on different aircraft. In the military and civil markets, standards were established. The first applications of integrated modular avionics (IMA) were on the USAF's F-22, on the military side, and on the Boeing 777, on the civil one. However, it must be emphasized that the actual implementations of the IMA concepts are not yet delivering all the expected benefits. New implementations are now under design.

Author (AIAA)

Avionics; Systems Integration

19980071959

Characterizing the commercial avionics thermal environment for field reliability assessment

Cluff, Kevin D., Honeywell, Inc., USA; Robbins, Dan, Honeywell, Inc., USA; Edwards, Tom, Honeywell, Inc., USA; Barker, Donald B., Maryland, Univ., College Park; Institute of Environmental Sciences, Journal; Aug. 1997; ISSN 1052-2883; Volume 40, no. 4, pp. 22-28; In English; Copyright; Avail: Aeroplus Dispatch

This paper demonstrates a practical methodology to measure and characterize the dynamic thermal history of the commercial airplane environment. To reduce irregular field thermal cycles, an algorithm is presented that preserves key information necessary for viscoplastic solder fatigue analysis. As an example, the IPC solder model will be used to evaluate 20 termination leadless ceramic chip carriers on nonconstrained printed wiring boards. This methodology will enable more realistic thermal fatigue reliability assessments and acceleration test specifications.

Author (AIAA)

Avionics; Reliability Analysis; Thermal Environments; Commercial Aircraft; Thermal Fatigue; Component Reliability; Electronic Equipment Tests

19980072342

Enhancing taxi performance under low visibility - Are moving maps enough?

McCann, Robert S., San Jose State Univ. Foundation, USA; Andre, Anthony D., San Jose State Univ. Foundation, USA; Begault, Durand, San Jose State Univ. Foundation, USA; Foyle, David C., NASA Ames Research Center, USA; Wenzel, Elizabeth, NASA Ames Research Center, USA; 1997, pp. 37-41; In English

Contract(s)/Grant(s): RTOP 538-04-13; Copyright; Avail: Aeroplus Dispatch

We report the results of an experiment evaluating the separate and combined effects of a 3D perspective moving map and newly developed HUD symbology on taxi performance in low visibility. Nine commercial airline pilots completed a series of gate-to-runway taxi routes at a simulated Chicago-O'Hare. Relative to a baseline condition, in which in-the-cockpit navigation support was confined to a Jeppesen paper map, the 3D moving map yielded an insignificant increase in taxi speed. The combination of an electronic moving map and HUD yielded a considerably larger and statistically significant increase in taxi speed. These results suggest that in low visibility, HUDs can substantially improve taxi performance over and above any improvements associated with 3D moving maps.

Author (AIAA)

Taxiing; Low Visibility; Head-Up Displays; Airline Operations; Pilot Performance; Airfield Surface Movements

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19980049050

Dynamics of aircraft and jet-engine prototypes for military, civil and RPV thrust vectoring flight control

Sherbaum, V., Technion - Israel Inst. of Technology, Haifa, Israel; Lichtsinder, M., Technion - Israel Inst. of Technology, Haifa; 1998, pp. 274-284; In English; Copyright; Avail: Aeroplus Dispatch

Thrust vectoring flight control (TVFC) is an emerging aircraft technology that is currently being introduced into such programs as the F-22, JSF, SU-37, SU-30MKI, and SU-32. TVFC has also been proposed recently for regional and airline jets and for some remotely piloted vehicles (RPVs). A critical issue in designing such TVFC aircraft, or in-flight testing of their dynamically scaled prototypes, is the difference between geometrical and effective jet-engine-nozzle deflection angles. This difference, and some others discussed in this paper, include the change in thrust levels due to geometric deflections and due to TVFC, speed, and altitude. For preliminary and conceptual design, these effects are first discussed and demonstrated. Then a new prototype flight-testing methodology is presented and illustrated by some calculated examples.

Author (AIAA)

Aircraft Engines; Remotely Piloted Vehicles; Flight Mechanics; Jet Engines; Thrust Vector Control; Aircraft Design

19980049294

Improvements in fighter engine effectiveness through thrust vectoring

Bursey, Roger, Pratt & Whitney, USA; Berger, Curtis, Pratt & Whitney, USA; Baker, Karen, Pratt & Whitney, USA; Wood, Bruce, Pratt & Whitney, USA; 1998, pp. 285-293; In English; Copyright; Avail: Aeroplus Dispatch

With the end of the cold war, the U.S. military has, by necessity, become focused on cost-effective, technically innovative, and highly integrated programs to meet future requirements. In order to do ’more with less’, customers and contractors have formed integrated product development teams for the purpose of demonstrating emerging technologies on existing platforms prior to entering full-scale production. Pratt & Whitney in partnership with the U.S. Air Force Wright Laboratories and NASA Dryden Flight Research Center and in conjunction with Boeing and Lockheed Martin Tactical Aircraft Systems, has successfully demonstrated an innovative approach to upgrade the capabilities of existing F-15 and F-16 aircraft through the incorporation of thrust vectoring exhaust nozzles into current Pratt & Whitney F100 fighter engines. by following the same rigorous design, manufacturing, development, integration, and test program, Pratt & Whitney has matured thrust vectoring nozzles to the point where they have entered production on the U.S. Air Force’s newest fighter, the F-22 Raptor. This paper describes the engineering fundamentals required to incorporate thrust vectoring, presenting design considerations and results obtained from the F-15 S/MTD (Short takeoff and landing Maneuver/Technology Demonstrator), F-15 ACTIVE (Advanced Control Technologies for Integrated Vehicles), and F-16 VISTA (Variable-stability In-flight Simulator Test Aircraft) flying test-bed aircraft.
Author (AIAA)
Fighter Aircraft; Aircraft Engines; Thrust Vector Control; Cost Effectiveness; Aircraft Design

19980050559
High altitude turbocharger
Lior, D., Technion - Israel Inst. of Technology, Haifa, Israel; 1998, pp. 70-75; In English; Copyright; Avail: Aeroplus Dispatch

A compact high pressure ratio turbocharger for engines operating at high altitude is proposed. Operating at a pressure ratio of 40:1, an altitude of 80,000 ft is attainable. This turbocharger may be adapted to supply compressed air to internal combustion engines, and, with sizing for increased airflow, may be adapted for aircraft gas turbines. The turbocharger design concept results in constant power for the aircraft engine from 0 level up to 80,000 ft. It is specially sized for slow aircraft flying at high altitudes, in which the power requirements are about 100 kW, although high power ratings may be attained with proper sizing.
Author (AIAA)
Aircraft Engines; Turbocompressors; Superchargers; High Altitude; Compressed Air; Engine Design

19980050985
Geared-turbofan engine design targets cost, complexity
Kandebo, Stanley W., USA; Aviation Week & Space Technology; Feb. 23, 1998; ISSN 0005-2175; Volume 14, no. 8, pp. 34, 35; In English; Copyright; Avail: Aeroplus Dispatch

The engineering of the new Pratt & Whitney PW8000 geared turbofan engine is discussed. The design will allow the engine to have 40 percent fewer stages and 50 percent fewer airfoils than existing conventional turbofans of comparable thrust.
AIAA
Turbofan Engines; Engine Design

19980051554
Numerical analysis of the transient responses of blades under different strain rates due to bird impact
Chen, Wei, Nanjing Univ. of Aeronautics and Astronautics, China; Wen, Weidong, Nanjing Univ. of Aeronautics and Astronautics, China; Gao, Deping, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 96-99; In Chinese; Copyright; Avail: Aeroplus Dispatch

When birds strike an the aeroengine, the deformations of the blades usually occur at high strain rates. Because the performance of the material changes with the alternation of the strain rates, it is necessery to consider this change in calculating the transient responses of the blades. In this paper, the transient response of the blades is calculated under two different strain rates by using a model blade. The results show that the twist deformation and the local deformation are small and the time period of blade vibration becames large at high strain rates.
Author (AIAA)
Numerical Analysis; Strain Rate; Bird-Aircraft Collisions

19980051604
Pratt & Whitney launches geared turbofan engine
Kandebo, Stanley W., USA; Aviation Week & Space Technology; Feb. 23, 1998; ISSN 0005-2175; Volume 14, no. 8, pp. 32-34; In English; Copyright; Avail: Aeroplus Dispatch

This paper discusses Pratt & Whitney’s new PW8000 geared turbofan engine, which has the potential to profoundly affect commercial transport aviation. If it performs as predicted, the PW8000 will be quieter, cleaner, and significantly more fuel-effi-

cient than existing turbofans in the 25,000-35,000 lb thrust range. The engine design is discussed and the competition provided by CFM International in the small commercial turbofan market is examined.
AIAA
Turbofan Engines; Engine Design; Aircraft Engines

19980051648
Active control of fan tones radiated from turbofan engines
Joseph, P., Southampton, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The potential of active control for controlling the fan tones radiated from turbofan engine inlets which dominate the radiated noise form an aircraft on approach is discussed. It is shown that the maximum theoretical performance of a realistic control system applied to a typical turbofan engine given complete observability of the radiated sound field is significant. Two control objects are discussed: the minimization of the total in-duct transmitted sound power and the minimization of the sound power radiated into a predefined band of sideline angles. This latter control objective is shown to be the most effective. A practical technique is proposed to implement the control via in-duct error sensors on the duct inlet wall.
AIAA
Aeroacoustics; Active Control; Noise Reduction; Turbofan Engines; Sound Waves; Fans

19980053607 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Antriebstechnik, Cologne, Germany
Numerical Simulation of the Unsteady Flow through Turbomachinery Components ***Numerische Simulation der Instationaeren Stroemung in Turbomaschinenkomponenten***
Engel, Karl, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; 1997; ISSN 0939-2963; 140p; In German; Original contains color illustrations; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Different numerical models and algorithms for the calculation of the unsteady flow through turbomachinery components are presented and discussed in relation to massively-parallel computer architecture. The work begins with the design and implementation of a parallel software environment which is shaped to the specific needs of the application and features an interactive control as one important element. The interactive control unit is directly linked to the flow solver unit by appropriate implementation of a variety of boundary conditions. For reasons of numerical accuracy, high resolution finite difference upwind schemes with TVD properties are considered for the discretization of the convective terms. Using unsteady test cases, the time accuracy of different formulations is assessed in terms of the numerical dissipation and dispersion error. Furthermore, the problem of efficient and fully scaled parallelization of the numerical methods is addressed. Finally, the usefulness of the developed system is demonstrated by a calculation of the inviscid, two-dimensional, unsteady flow through a transonic compressor stage. Typical handling problems, which are encountered in turbomachinery flow simulations, such as an efficient initialization, choice of boundary conditions, and numerical solution techniques are discussed.
Author
Unsteady Flow; Turbomachinery; Computational Fluid Dynamics; Parallel Processing (Computers); Finite Difference Theory; TVD Schemes

19980054636
Implementing monitoring and zooming in a heterogeneous distributed jet engine simulation
Afjeh, A. A., Univ. of Toledo, USA; Homer, P. T.; Lewandowski, H.; Reed, J. A.; Schlichting, R. D.; Simulation; Oct, 1997; ISSN 0037-5497; Volume 69, no. 4, pp. 205-218; In English; Copyright; Avail: Issuing Activity

The NASA Numerical Propulsion System Simulation project explores the use of computer simulation to facilitate the design of new jet engines. Several key issues raised in this research are being examined in an NPSS-related research project: zooming, monitoring and control, and support for heterogeneity. The design and implementation of a distributed simulation executive that addresses each of these issues is described. In this work, the strategy of zooming, which allows codes that model at different levels of fidelity to be integrated within a single simulation, is applied to the fan component of a turbofan propulsion system. A prototype monitoring and control system provides continuous updates on the progress of the simulation and a platform for experimenting with active control techniques. An inter-connection system provides a transparent means of connecting the heterogeneous systems that comprise the prototype.
Author (EI)
Jet Engines; Computerized Simulation; Turbofan Engines

19980055270

Thermal load on a scramjet combustion chamber

Juergens, B. U., JPL, USA; Koschel, W. W., German Aerospace Research Establishment, Space Propulsion Div., Hardthausen am Kocher, Germany; 1998, pp. 425-430; In English; Copyright; Avail: Aeroplus Dispatch

A coupled fluid-structural thermal solver that simultaneously solves the compressible Navier-Stokes equations for high-speed flows and the heat transfer equation in an adjacent multilayer structure using adaptive hybrid grids is presented. A Baldwin-Lomax turbulence model and a zonal gas radiation model are incorporated, and two test problems are computed. The procedure is then applied to analyze the thermal load on a scramjet combustion chamber, and comparisons with experimental hydrogen combustion are presented.

Author (AIAA)

Supersonic Combustion Ramjet Engines; Combustion Chambers; Aerodynamic Heat Transfer; Baldwin-Lomax Turbulence Model

19980055457

Fuel injector characterization using laser diagnostics at atmospheric and elevated pressures

Zelina, Joseph, AlliedSignal Engines, USA; Rodrigue, Allan, AlliedSignal Engines, USA; Sankar, Subra, Aerometrics, Inc., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS3-27752

Report No.(s): AIAA Paper 98-0148; Copyright; Avail: Aeroplus Dispatch

Prefilming, piloted, and macrolaminate piloted airblast injectors were studied using Malvern, optical patternation, and a phase Doppler particle analyzer at atmospheric and elevated pressures. Malvern data showed similar values of Sauter mean diameter for the three configurations tested ranging from 20-48 microns, depending on axial distance from the tip and fuel injector type. Volume concentration data obtained from optical patternation agreed quite well with data obtained with phase Doppler particle analyzer, except at the injector centerline, which could be a result of out-of-plane scatter. High pressure phase Doppler particle analyzer data indicated that a matched momentum ratio technique resulted in similar spray geometry, fuel spray velocity, and volume flux profiles for the prefilming airblast injector. Optical patternation results showed good agreement between Sauter mean diameter collected from this technique and phase Doppler particle analyzer data from -15 to 15 mm through the injector centerline. Results demonstrated that optical patternation can provide quantitative, nonintrusive measurements of spray volume concentration and Sauter mean diameter spatial distribution.

Author (AIAA)

Fuel Injection; Characterization; High Pressure; Atmospheric Pressure

19980055465

Optimization of jet mixing into a rich, reacting crossflow

Leong, M. Y., California, Univ., Irvine, USA; Samuelsen, G. S., California, Univ., Irvine; Holdeman, J. D., NASA Lewis Research Center, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG3-1110

Report No.(s): AIAA Paper 98-0156; Copyright; Avail: Aeroplus Dispatch

Radial jet mixing of pure air into a fuel-rich, reacting crossflow confined to a cylindrical geometry is addressed with a focus on establishing an optimal jet orifice geometry. The purpose of this investigation was to determine the number of round holes that most effectively mixes the jets with the mainstream flow, and thereby minimizes the residence time of near-stoichiometric and unreacted packets. Such a condition might reduce pollutant formation in axially staged, gas turbine combustor systems. Five different configurations consisting of 8, 10, 12, 14, and 18 round holes are reported here. An optimum number of jet orifices is found for a jet-to-mainstream momentum-flux ratio of 57 and a mass-flow ratio of 2.5. For this condition, the 14-orifice case produces the lowest spatial unmixedness and the most uniformly-distributed species concentrations and temperature profiles at a plane located one duct diameter length from the jet orifice inlet.

Author (AIAA)

Cross Flow; Fuel-Air Ratio; Reacting Flow; Mixing; Air Jets; Holes (Mechanics); Inlet Flow; Engine Design

19980055466

Multicomponent fuel effects on the vaporization of a surrogate single-component fuel droplet

Aggarwal, S. K., Illinois, Univ., Urbana, USA; Shu, Z., Illinois, Univ., Urbana; Mongia, H., GE Aircraft Engines, USA; Hura, H. S., GE Aircraft Engines, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0157; Copyright; Avail: Aeroplus Dispatch

This paper deals with the multicomponent nature of gas turbine fuels. The current spray models used for predicting two-phase flows in a gas turbine combustor are based on a single-component droplet vaporization submodel, although it is well known that gas turbine fuels are mixtures of many compounds with wide variations in properties. The major objective of this paper is to examine if the vaporization behavior of a multicomponent fuel droplet can be represented by a surrogate single-component droplet. The physical system considered is that of a multicomponent fuel droplet of known initial composition undergoing quasi-steady vaporization in an environment characterized by its temperature, pressure, and composition. Using different vaporization models, such as infinite-diffusion and diffusion-limit models, the predicted vaporization history and other relevant properties of the bicomponent droplet are compared with those of an equivalent single-component droplet. Results indicate that a suitably selected single-component fuel can be used to represent the vaporization behavior of a bicomponent fuel under a wide range of ambient temperature and droplet diameters. However, the temporal evolution of the vaporization rates indicates that the diffusion-limit model be employed in simulating the vaporization behavior of the corresponding multicomponent spray by an equivalent single-component fuel spray.
Author (AIAA)
Gas Turbine Engines; Two Phase Flow; Vaporizing

19980055536

On the characteristics of turbulent multiple jets diffusion flame. II - Reactive flow

Alfahaid, A. F., Old Dominion Univ., USA; Mohieldin, T. O., Old Dominion Univ., USA; Tiwari, S. N., Old Dominion Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0245; Copyright; Avail: Aeroplus Dispatch

A numerical study to investigate the reactive flow characteristics of stacked injectors, pertaining to flow conditions chosen to simulate the flow in a scramjet combustor, is presented. The steady compressible Reynolds averaged Navier-Stokes equations are solved numerically using a finite volume approach and a quadratic upwind interpolation scheme. The equation system was closed using the two-equations k-epsilon turbulence model. A four-species, one reaction, global finite rate chemistry model is used to simulate the combustion processes. The influence of turbulence on the reaction rate is taken into account by considering finite rate burning, based on the rate of decay of large turbulent eddies into small ones. Effect of subsonic injection into supersonic streams which results in weakening the ability of the boundary layer to separate, and its effect on the flame structure and stability is investigated. The results show that supersonic mixing and combustion is strongly affected by subsonic injection, and for the conditions employed, ignition and combustion is enhanced by the tandem injection, especially at high subsonic Mach numbers. Results also indicate that for certain conditions, using single injection autoignition is impossible and in some cases the flame is extinguished.
Author (AIAA)
Turbulent Flames; Diffusion Flames; Jet Mixing Flow; Reacting Flow; Combustion Chemistry; Supersonic Combustion Ramjet Engines; Computational Fluid Dynamics; Combustion Chambers; Injectors; Gas Injection

19980055538

Effect of mixer geometry on fuel spray distribution, emissions and stability

Ateshkadi, A., California, Univ., Irvine, USA; McDonell, V. G., California, Univ., Irvine; Samuelsen, G. S., California, Univ., Irvine; Jan. 1998; In English

Contract(s)/Grant(s): F49620-95-C-0080

Report No.(s): AIAA Paper 98-0247; Copyright; Avail: Aeroplus Dispatch

Radial mixer hardware consisting of four parameters (primary and secondary swirl vane angles, the presence of a venturi, and the coswirl/counterswirl sense) was examined. The design was developed to maintain constant effective area and overall dimensions. The responses selected for study were fuel distribution, emission and stability. Studies were conducted to verify good symmetry of sprays produced. A heavy dependence of the fuel distribution on swirler configuration was observed. Swirl sense and the presence of the venturi resulted in the most notable differences in the spray distribution. In terms of combustion performance, counterswirl decreased the lean blowout equivalence ratio compared to coswirl. Emission measurements taken at the exit plane of the combustor revealed no specific geometric parameter(s) that affected the emission performance. That no main effects were observed for emissions suggests a complex dependency. Four classes of NO(x) and CO performers were identified based on hardware configuration variations.
Author (AIAA)
Fuel Sprays; Mixers; Radial Distribution; Nozzle Geometry; Exhaust Emission; Flame Stability

19980055556

Fuel-air mixing under simulated high pressure and high temperature conditions

Goetz, Jochen, Maryland, Univ., College Park, USA; Gupta, Ashwani K., Maryland, Univ., College Park; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0269; Copyright; Avail: Aeroplus Dispatch

A method to characterize and understand fuel/air mixing under simulated high temperature and high pressure conditions is presented. These conditions were simulated using an isothermal liquid flow facility and model coannular swirl burner. At increased pressures and temperatures the thermophysical properties (e.g. viscosity, vapor density) change which subsequently provides an influence on the fuel-air mixing, combustion efficiency, flame stability and generation of unwanted emissions. The results provide the effect of different flowrates and burner exit geometry (burner quarls made of quartz glass) on the mixing behavior in the turbulent swirling flames. Planar laser-induced fluorescence (PLIF) diagnostics have been used to analyze the fuel-air mixing behavior under various conditions. A series of photographs of the flow field for 12 different cases have provided information on the evolutionary behavior of local and global flow structures in the flow field. Time-averaged information on the flow field was obtained by averaging the desired number of photographs using an image processing soft-ware. Statistical evaluation on the scale and intensity of segregation has been determined for all cases using PLIF photographs of both the individual and time averaged results. The important role of burner geometry and flow parameters on mixing and its subsequent effect on combustion characteristics in advanced gas turbine combustors is demonstrated.

Author (AIAA)

High Pressure; High Temperature; Liquid Flow; Combustion Efficiency; Gas Turbine Engines

19980055723

An empirical prediction of inlet radiated broadband noise from full scale engines

Nesbitt, E. H., Boeing Commercial Airplane Group, USA; Ganz, U. W., Boeing Commercial Airplane Group, USA; Diamond, J. A., Boeing Commercial Airplane Group, USA; Kosanchik, M., III, Boeing Commercial Airplane Group, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0470; Copyright; Avail: Aeroplus Dispatch

An empirical prediction has been developed for inlet radiated broadband noise using full-scale engine data. Data from several modern high by-pass ratio engines in use on current production Boeing aircraft were used. The data are from hardwall static engine tests using 150-ft polar arc ground microphones and have been corrected to free field. A technique has been developed and used for this study which separates noise by sources (i.e., jet noise, turbine noise, and fan and LPC tone noise) using narrowband and 1/3-octave band data. This study explores the possible sources of inlet radiated broadband noise using full-scale engine data. With some understanding of the possible sources, a method was developed that uses correlating parameters to reduce the differences between measured and predicted data. The correlation equation and comparisons of predictions with data are presented.

Author (AIAA)

Broadband; Engine Noise; Noise Prediction (Aircraft); Engine Inlets; Turbofan Engines; Aircraft Engines

19980055808

F-22 inlet and duct ice detection and accretion test

West, Timothy G., Lockheed Martin Aeronautical Systems, USA; Luttrell, Jeffery P., Lockheed Martin Aeronautical Systems, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0572; Copyright; Avail: Aeroplus Dispatch

A full-scale Lockheed Martin F-22 Raptor engine inlet and duct icing model was tested in the NASA Icing Research Tunnel to assess ice detector configurations and quantify ice accretion characteristics. Test conditions included temperatures from -4 to 28 F, liquid water contents from 0.31 to 2.82 g/cu m, and median volumetric diameters of 14 and 30 microns. The attitude, airspeed, and inlet airflows simulated landing approach conditions. An optimum ice detection configuration was selected from six candidates. The preferred configuration was a probe-type ice detector located approximately three feet forward of the aerodynamic interface plane in the lower outboard section of the duct. Ice thickness on the inlet was measured. Accretion rates were derived from the measured ice thickness and compared to analytical predictions.

Author (AIAA)

F-22 Aircraft; Aircraft Icing; Engine Inlets; Ducted Flow; Temperature Measurement

19980055921

Application of laser Doppler velocimetry to aircraft gas turbine exhaust flow

Rudoff, R. C., Aerometrics, Inc., USA; Bachalo, W. D., Aerometrics, Inc., USA; Ennix, K., NASA, USA; Conners, T., NASA, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS2-13572
Report No.(s): AIAA Paper 98-0708; Copyright; Avail: Aeroplus Dispatch

A Laser Doppler Velocimeter (LDV) is applied to the exhaust flow of an F-100 EMD gas turbine engine. Measurements of the exhaust flow field are made with and without artificial seeding under run conditions ranging from idle to military power. Inlet LDV measurements for the engine are also obtained. Such measurements could nonobtrusively help refine exhaust and inlet geometry design, determine thrust, and provide control system feedback. The LDV offers high temporal and spatial resolution, and when combined with state-of-the-art frequency-domain signal processing is capable of making these measurements with minimal laser power. The LDV is also capable of withstanding the harsh vibrations and temperature found near the engine. Single-component profiles of axial mean and rms velocity are shown for three run conditions, along with transient velocity data. An estimate of LDV data rate versus laser power was also determined. The results show that LDV may be effectively applied to full scale engines inlets and exhausts, but that seeding methodology needs added development if measurements throughout all regions of the exhaust or inlet are to be effectively measured.

Author (AIAA)

Laser Doppler Velocimeters; Gas Turbine Engines; Jet Exhaust; Flow Measurement; Exhaust Flow Simulation; Flow Velocity

19980055923

Specification of combustor entrance conditions in ground-based scramjet testing

Cutler, A. D., Joint Inst. for the Advancement of Flight Sciences, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0710; Copyright; Avail: Aeroplus Dispatch

This paper presents a systematic method for the specification of ramjet/scramjet test facility air simulant and fuel simulant composition and entrance conditions. An analysis of the governing equations is performed to identify a minimum set of dimensionless variables and dimensionless closure relationships. The enthalpy closure, which relates dimensionless enthalpy to dimensionless pressure, density and composition, is studied assuming (1) calorically perfect gases and complete reaction, and (2) real enthalpy temperature relationships and equilibrium chemistry. Best air simulant compositions for typical combustion-heated facilities are identified by matching the enthalpy closure relationship for the simulants to flight. The air simulant compositions so identified are tested in simple calculations of a scramjet combustor and nozzle which assume two-stream quasi-1D flow. Results for the new simulation strategy are compared to results for simulants constituted in the conventional manner and to flight.

Author (AIAA)

Specifications; Combustion Chambers; Supersonic Combustion Ramjet Engines; Dimensionless Numbers

19980055930

Measurements of spray properties and mixing in a simulated combustor

Aung, K., Georgia Inst. of Technology, Atlanta, USA; Liang, S., Georgia Inst. of Technology, Atlanta; Seitzman, J., Georgia Inst. of Technology, Atlanta; Jagoda, J., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Contract(s)/Grant(s): DAAH04-96-1-0008
Report No.(s): AIAA Paper 98-0717; Copyright; Avail: Aeroplus Dispatch

The present study reports detailed measurements of the characteristics of an isothermal dilute spray in a well-defined turbulent flow field. The objective is to provide benchmark comprehensive measurements of spray evaporation, mixing, and combustion in a simulated combustor. A two-component phase Doppler particle analyzer was used to measure local droplet size and velocity distributions, liquid volume fluxes, number density and gas phase turbulence properties. Measurements were made to provide a complete set of initial conditions for both gas and liquid phases, which is essential for accurate prediction of spray and gas properties downstream. Radial profiles of both gas and liquid phase properties at several downstream positions were measured for validation with future computations. Present measurements may also be used to improve our understanding of the physical mechanisms that control the evaporation and combustion of sprays, and to develop and validate improved models for CFD.

Author (AIAA)

Spray Characteristics; Turbulent Mixing; Combustion Chambers; Fuel Sprays; Flow Measurement

19980055931

Measurement of spray/acoustic coupling in gas turbine fuel injectors

Anderson, Torger J., United Technologies Research Center, USA; Kendrick, Donald W., United Technologies Research Center, USA; Cohen, Jeffrey M., United Technologies Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0718; Copyright; Avail: Aeroplus Dispatch

A diagnostic to measure the acoustic coupling of air flow with a fuel injector spray has been developed and tested. The instrument measures the mass of fuel within a plane of the spray using planar laser-induced fluorescence. The signal is monitored contin-

uously to measure mass flow fluctuations during acoustic excitation of the flow. A comparison with the acoustic signal provides a measure of the response of the spray to acoustic excitation for a given nozzle design. This paper describes the approach to acquiring a planar-integrated time-dependent signal for response measurements. Results for several nozzle designs are also presented.
Author (AIAA)
Gas Turbine Engines; Fuel Injection; Acoustic Coupling; Fuel Sprays; Fuel Flow

19980055938
Numerical simulation of internal flow in aircraft engine by parallel super computer
Makida, Mitsumasa, National Aerospace Lab., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0725; Copyright; Avail: Aeroplus Dispatch

A parallel numerical simulation code for the 3D flow fields in an aircraft combustor, including liquid fuel spray, has been developed. In this code, the Euler equations are used for the fuel droplets' liquid phase, assuming continuous fluid, and the full Navier-Stokes equations are applied for the gas phase. Both phases are connected through mass, momentum, and energy exchange equations, and solved simultaneously. The liquid phase has a radius distribution, and is divided into five groups of different initial radius, and they are also treated as individual phases. The vaporization and the combustion of fuel droplets are included in the calculations. Both phases are solved by the finite difference method, and the Harten-Yee's explicit non-MUSCL modified-flux type TVD scheme is applied to convective terms, and the central difference scheme is applied to viscous terms of the gas phase. A model flow field of the liquid fuel combustor, which has a swirler inlet region, is numerically simulated by a parallel super computer, and some results are presented.
Author (AIAA)
Aircraft Engines; Combustion Chambers; Multiphase Flow; Parallel Processing (Computers); Liquid Fuels; Fuel Sprays

19980056006
Emissions measurements from a lobed fuel injector/burner
Mitchell, M. G., California, Univ., Los Angeles, USA; Smith, L. L., California, Univ., Los Angeles; Karagozian, A. R., California, Univ., Los Angeles; Smith, O. I., California, Univ., Los Angeles; Jan. 1998; In English
Contract(s)/Grant(s): N00014-93-1-1383; NCC2-374
Report No.(s): AIAA Paper 98-0802; Copyright; Avail: Aeroplus Dispatch

The present experimental study examines NO(x) and CO emissions associated with alternative fuel injector geometries. These injectors mix fuel and air to differing extents, and thus create different local equivalence ratios upstream of flame ignition and stabilization. Two of the devices studied are lobed fuel injectors, in which mixing of reactants is associated with streamwise vorticity generation and straining of fuel-air interfaces, while the third is a nonlobed fuel injector which creates relatively little fuel-air mixing prior to ignition. Results show that one lobed injector geometry appears to produce locally lean premixed flame structures, resulting in low NO(x) emissions when compared with nonlobed injector emissions. The other lobed injector geometry appears to produce a local fuel-air mixture which is closer to stoichiometric conditions, with NO(x) emissions that are actually higher than for the nonlobed injector. For both lobed injector geometries examined here, CO emissions become high for overall lean operating conditions, consistent with premixed combustion behavior. The present study demonstrates the importance of control of the local equivalence ratio in minimizing burner emissions.
Author (AIAA)
Fuel Injection; Burners; Carbon Monoxide; Nitrogen Oxides; Exhaust Gases; Fuel-Air Ratio; Pollution Control; Aircraft Engines

19980056037
Automated cooling design methodology for combustor walls
Kumar, Ganesh N., ACRi, Inc., USA; Rettig, Mark, GE Aircraft Engines, USA; Mongia, Hukam, GE Aircraft Engines, USA; Chauvette, Claude, GE Aircraft Engines, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0836; Copyright; Avail: Aeroplus Dispatch

An automated cooling design procedure for aircraft engine combustors has been developed which uses a converged CFD flow solution and produces a detailed temperature distribution in the liners, dome, etc., of a combustor. The output of the automated procedure is the following: a detailed wall temperature and heat flux distribution; arrangement of effusion-cooling holes, starter slots, and impingement cooling holes; and cooling flow splits in various zones, which produce acceptable wall temperatures for the most severe cycle conditions imposed on the engine.
Author (AIAA)
Methodology; Aircraft Engines; Combustion Chambers; Automation; Engine Design

19980056100

Multi-objective optimization of mixed-stream turbofan engines

Nadon, Luc J. J. P., USAF, Inst. of Technology, USA; Kramer, Stuart C., USAF, Inst. of Technology, USA; King, Paul I., USAF, Inst. of Technology, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0910; Copyright; Avail: Aeroplus Dispatch

Aircraft engine design requires balancing a number of conflicting objectives, such as maximizing performance and minimizing fuel use, size, and cost. Current practice is typically a manual, sequential approach, in which the designer considers objectives one at a time. It also requires the designer to apply implicit judgment in making the tradeoffs. An alternative approach is to apply multiobjective optimization techniques to address all the conflicting objectives. This paper presents preliminary results of an effort to develop such an integrated, automated optimization program for jet aircraft engine. As an example, the procedure is used to optimize fuel use, cost, and size of an engine for a conceptual short-range interceptor. The process, however, is nonspecific and can be applied to a wide variety of missions and aircraft.

Author (AIAA)

Optimization; Turbofan Engines; Aircraft Engines; Engine Design; Jet Aircraft

19980056122

Parametric studies of the ejector process within a turbine-based combined-cycle propulsion system

Georgiadis, Nicholas J., NASA Lewis Research Center, USA; Walker, James F., NASA Lewis Research Center, USA; Trefny, Charles J., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0936; Copyright; Avail: Aeroplus Dispatch

The ejector process within a turbine-based combined-cycle (TBCC) propulsion system is investigated using the NPARC Navier-Stokes code. The TBCC concept integrates a turbine engine with a ramjet into a single propulsion system that may efficiently operate from takeoff to high Mach number cruise. At the operating point considered, corresponding to a flight Mach number of 2.0, an ejector serves to mix flow from the ramjet duct with flow from the turbine engine. The combined flow then passes through a diffuser where it is mixed with hydrogen fuel and burned. Three sets of fully turbulent Navier-Stokes calculations are compared with predictions from a cycle code developed specifically for the TBCC propulsion system. A baseline ejector system is investigated first. The Navier-Stokes calculations indicate that the flow leaving the ejector is not completely mixed, which may adversely affect the overall system performance. Two additional sets of calculations are presented; one set that investigated a longer ejector region (to enhance mixing) and a second set which also utilized the longer ejector but replaced the no-slip surfaces of the ejector with slip (inviscid) walls in order to resolve discrepancies with the cycle code. The three sets of Navier-Stokes calculations and the TBCC cycle code predictions are compared to determine the validity of each of the modeling approaches.

Author (AIAA)

Ejectors; Navier-Stokes Equation; Ramjet Engines; Turbine Engines; Takeoff

19980056123

An investigation of advanced fuel injection schemes for scramjet combustion

Baurle, R. A., Taitech, Inc., USA; Fuller, R. P., Taitech, Inc., USA; White, J. A., Taitech, Inc., USA; Chen, T. H., Taitech, Inc., USA; Gruber, M. R., USAF, Research Lab., USA; Nejad, A. S., USAF, Research Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0937; Copyright; Avail: Aeroplus Dispatch

The objective of this investigation is to compare and evaluate the cold flow mixing effectiveness of two popular fuel injection schemes for scramjet combustion; strut and ramp injectors. The performance evaluation is based on a combination of Computational Fluid Dynamics (CFD) and experimental measurements. The CFD calculations were carried out using the VULCAN (Viscous Upwind aLgorithm for Complex flow ANalysis) Navier-Stokes solver, and the experiments were conducted at the Air Force Research Lab supersonic mixing/combustion facility located at Wright Patterson Air Force Base. Results show the strut configuration to have superior mixing characteristics over the ramp configuration, with approximately the same total pressure loss. Overall, the comparison with preliminary experimental data was encouraging, and several flow features were identified that explained the behavior indicated by the far field measurements.

Author (AIAA)

Fuel Injection; Supersonic Combustion Ramjet Engines; Mixing Layers (Fluids); Computational Fluid Dynamics

19980056126

Hypersonic combustion and mixing studies using simultaneous OH-PLIF and schlieren imaging

Ben-Yakar, Adela, Stanford Univ., USA; Kamel, Michel, Stanford Univ., USA; Morris, Christopher, Stanford Univ., USA; Hanson, Ronald K., Stanford Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0940; Copyright; Avail: Aeroplus Dispatch

This paper describes an experimental effort to characterize the flame-holding process of a hydrogen jet injected into a high total enthalpy supersonic-cross-flow. An expansion tube is used to provide a correct simulation of true flight combustion chemistry, including ignition delay and reaction times. This approach permitted a number of unique experiments involving acceleration of radical-free air to high total enthalpies. The experiments were designed to map the near-field flow characteristics and autoignition process of an underexpanded transverse hydrogen jet injected into fiight-Mach number 10 total enthalpy flow conditions. Flow visualization techniques included planar laser-induced fluorescence (PLIF) of OH and schlieren imaging applied simultaneously. Schlieren images show the shock structure around the jet and the periodically formed coherent structures in the jet/freestream interface. Overlaid OHPLIF and schlieren images allow characterization of the autoignition of a hydrogen jet in air crossflow for different jet-to-freestream momentum flux ratios at both flow conditions. The first OH signals are obtained in the recirculation region upstream of the jet exit and in the bow shock region, while in past experiments with similar geometry but lower total enthalpy conditions. The OH-PLIF results for Mach 10 conditions show that the OH signal level decreases significantly as the mixture expands around the jet flowfield, indicating a partial quenching of the ignition. This indicates that combustion of hydrogen and air in these high total enthalpy conditions is a mixing-limited process. It is evident from the results that improved injection schemes will be required for practical applications in scramjet engines.

Author (AIAA)

Hypersonic Combustion; Laser Induced Fluorescence; Mixing Layers (Fluids); Hydroxyl Radicals; Schlieren Photography; Flow Visualization

19980056127

Supersonic combustion - A shock tunnel and vitiation-heated blowdown tunnel comparison

Boyce, R. R., Queensland, Univ., Australia; Wendt, M., National Aerospace Lab., Japan; Paull, A., Queensland, Univ., Australia; Chinzei, N., National Aerospace Lab., Japan; Stalker, R. J., Queensland, Univ., Australia; Miyajima, H., National Aerospace Lab., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0941; Copyright; Avail: Aeroplus Dispatch

A comparison has been made between supersonic combustion in two commonly used, but fundamentally different, facilities for scramjet research - a vitiation-heated blowdown tunnel and a free piston shock tunnel. by passing the shock tunnel freestream flow through a normal shock and then expanding it to Mach 2.5, combustor inlet conditions were nominally replicated between the two facilities, as were the combustor geometries. A straight rectangular duct and a diverging duct, both employing central strut hydrogen injection, were used. Boundary layer growth and separation in the straight duct limited meaningful comparisons to a fuel equivalence ratio phi of the order of 0.20. With the diverging duct, comparisons were made up to phi = 1.05. Reasonably good agreement between the two facilities was found, with differences attributable to differences in the flow parameters between the two facilities, particularly the total enthalpy and static temperature, and to the large water content of the vitiation-heated flow.

Author (AIAA)

Supersonic Combustion Ramjet Engines; Shock Tunnels; Blowdown Wind Tunnels

19980056128

Shock tunnel skin friction measurement in a supersonic combustor

Goyne, C. P., Queensland, Univ., Australia; Stalker, R. J., Queensland, Univ., Australia; Paull, A., Queensland, Univ., Australia; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0943; Copyright; Avail: Aeroplus Dispatch

Shock tunnel measurements are reported of skin friction with supersonic hydrogen-air combustion in a constant area duct. A floating element skin friction gauge was used, in which the shear force was applied directly to a piezoceramic measuring element. The experiments were conducted at stagnation enthalpies of 5.7 and 6.8 MJ/kg, a precombustion Mach number of approximately 4.5, and with a maximum duct Reynolds number of 1.3 x 10 exp 7. The measurements showed that the skin friction coefficient was unaffected by supersonic combustion, and could be predicted by the correlation of Spalding and Chi. Measurements of heat transfer also established that Reynolds analogy could be used in both the fuel-off and fuel-on flows.

Author (AIAA)

Shock Tunnels; Skin Friction; Supersonic Combustion; Ducted Flow; Hydrogen

19980056133

Thrust vector behavior of highly integrated asymmetric nozzles for advanced fighter aircraft

Berens, Thomas M., Daimler-Benz Aerospace AG, Germany; Bissinger, Norbert C., Daimler-Benz Aerospace AG, Germany; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0948; Copyright; Avail: Aeroplus Dispatch

The aerodynamic performance of three different geometry concepts of two-dimensional convergent/divergent nozzles with thrust vector control capability was investigated at flight Mach numbers 0.6 and 0.8 at sea level altitude. Under consideration of the external afterbody flowfield, Euler calculations were carried out for a nozzle with a slot exit, a nozzle with an S-shaped duct, and a nozzle configuration with injection of secondary air as coolant to reduce vectoring flap wall temperatures and for fluidic control of the gross thrust vector. As results of the CFD calculations of the nozzle/afterbody flow fields the thrust vector behavior is shown for a large range of nozzle pressure ratios, various pitch vectoring flap positions, and different mass flows of secondary air. Due to the asymmetry of the nozzle geometry, pitching moments are generated which change considerably when varying the nozzle pressure ratio from idle to maximum dry power operating conditions. The complex interaction between the external afterbody flow, the jet plume flow, and the secondary cooling air flow at subsonic Mach numbers leads to large changes of the longitudinal moment coefficients as a function of secondary air pressure ratios. Flowfield phenomena are demonstrated with isolines for Mach numbers and pressure coefficients together with pressure distributions along internal nozzle walls and external afterbody contours.

Author (AIAA)

Thrust Vector Control; Asymmetry; Nozzle Geometry; Fighter Aircraft; Aircraft Performance; Computational Fluid Dynamics

19980056147

A comparison of two hypermixing fuel injectors in a supersonic combustor

Gaston, Matthew J., New South Wales, Univ., Australia; Mudford, Neil R., New South Wales, Univ., Australia; Houwing, Frank, Australian National Univ., Australia; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0964; Copyright; Avail: Aeroplus Dispatch

An experimental study has been undertaken to evaluate the performance of two hypermixing injectors designed for supersonic combustion ramjet (scramjet) applications. Supersonic mixing and combustion studied in a free-piston driven shock tunnel is examined using surface pressure measurements and shadowgraphy. Tests were conducted at two inlet Mach numbers: 2.5 and 3.7.

Author (AIAA)

Fuel Injection; Supersonic Combustion Ramjet Engines; Pressure Measurement; Shadowgraph Photography; Mixing Layers (Fluids)

19980056148

Analysis of transient thermal choking processes in a model scramjet engine

O’Byrne, S., Australian National Univ., Australia; Doolan, M., Australian National Univ., Australia; Olsen, S. R., Australian National Univ., Australia; Houwing, A. F. P., Australian National Univ., Australia; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0965; Copyright; Avail: Aeroplus Dispatch

Shadowgraph flow visualization and floor static pressure measurements were used to examine the transient behavior of a thermally choked combusting flow. Experiments were performed to examine the effect of varying inlet Mach number and fuel-air equivalence ratio on the nature and extent of the interaction. In all cases a sudden increase in static pressure was measured, followed by a highly turbulent region of sonic flow, which was seen to propagate upstream along the duct. The nature of the dominant processes causing this pressure discontinuity are still not certain. Some mechanisms which may contribute to this phenomenon are presented. These include separation of the boundary layer in the duct, formation of a detonation, and formation of a near-normal shock wave by the region of thermally choked flow.

Author (AIAA)

Supersonic Combustion Ramjet Engines; Chokes (Fuel Systems); Flow Visualization; Pressure Measurement; Surges; Fuel-Air Ratio

19980056156

Application of parameter-dependent robust control synthesis to turbofan engines

Wolodkin, Greg, Minnesota, Univ., Minneapolis, USA; Balas, Gary J., Minnesota, Univ., Minneapolis; Garrard, William L., Minnesota, Univ., Minneapolis; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0973; Copyright; Avail: Aeroplus Dispatch

We apply recent results in multivariable robust control synthesis for linear parameter-varying (LPV) systems to the control of a turbofan engine over a wide range of power codes. Seven linear, time-invariant (LTI) models are used in the control design. This results in an LPV controller consisting of seven LTI controllers gain-scheduled via linear interpolation. A model-matching approach is employed such that the resulting closed loop resembles a decoupled set of second-order systems with specified rise

time and overshoot. The performance of linear point designs is compared with that of the LPV controller via closed-loop step responses, under both constant and parameter-varying conditions.
Author (AIAA)
Turbofan Engines; Control Systems Design

19980056187

Identification and control of a radial turbojet with neural network and fuzzy logic

Toprak, Suha, TUSAS Engine Industries, Inc., Turkey; Erkmen, Aydan M., Middle East Technical Univ., Turkey; Akmandor, I. S., Middle East Technical Univ., Turkey; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1016; Copyright; Avail: Aeroplus Dispatch

Our work focuses on the control of a radial turbojet manufactured by and available at TUSAS Engine Industries Inc., equipped with fifteen sensors. Such a system is a highly nonlinear dynamical system bearing parametric and nonparametric uncertainties in its dynamics and sensorial data acquisition. The System Identification of this radial turbojet engine has been realized using Artificial Neural Networks (ANN) methods, where static engine performance data have been processed. The ANN model for the engine behavior under consideration has two input, three output and is constructed with two hidden layers, each having ten nodes. A Fuzzy Logic Controller (FLC) successfully coupled to the engine models found to closely and reliably track the desired behaviors.
Author (AIAA)
Turbojet Engines; Engine Control; System Identification; Neural Nets

19980056198

Modeling non-premixed turbulent combustion in aeronautical engines using PDF-generator

Ravet, F., SNECMA, Direction Technique, France; Vervisch, L., Rouen, INSA; CORIA, St. Etienne-du-Rouvray, France; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1027; Copyright; Avail: Aeroplus Dispatch

The objective of the present work is to describe nonpremixed turbulent combustion models developed for simulating numerically the behavior of flames in aeronautical engines. A PDF generator technique combining the steady laminar flamelet assumption with a micromixing closure and reduced chemical scheme is proposed. A laboratory nonpremixed jet flame is first computed, then models are used to calculate aeronautical combustion chambers.
Author (AIAA)
Aircraft Engines; Turbulent Combustion; Diffusion Flames; Turbulent Flames

19980056563

Aircraft engine applications for gamma titanium aluminide

Austin, C. M., GE Aircraft Engines, USA; Kelly, T. J., GE Aircraft Engines, USA; McAllister, K. G., GE Aircraft Engines, USA; Chesnutt, J. C., GE Aircraft Engines, USA; 1997, pp. 413-425; In English; Copyright; Avail: Aeroplus Dispatch

Gamma titanium aluminide provides a unique set of properties that can lead to substantial payoffs in a range of aircraft engine applications. At least six components have been engine-tested successfully. At least two specific engine components are the targets of serious introduction efforts at this time. Progress in implementation is being paced by the development of economical manufacturing processes and the accumulation of engineering experience.
Author (AIAA)
Aircraft Engines; Titanium Aluminides; Intermetallics; Face Centered Cubic Lattices; Operating Temperature; Engine Parts

19980057169

Development of the CFRP compressor stator vane for gas-turbine

Yamagishi, Kenjiro, Research Inst. of Advanced Material Gas-Generator, Japan; Yagi, Hiroyuki, Research Inst. of Advanced Material Gas-Generator, Japan; Morita, Hideo, Research Inst. of Advanced Material Gas-Generator, Japan; Hamamoto, Akira, Research Inst. of Advanced Material Gas-Generator, Japan; 1997, pp. 1143-1146; In English; Copyright; Avail: Aeroplus Dispatch

An integrated composite stator vane segment using carbon fiber and thermoplastic polyimide resin has been developed. The segment was comprised of a continuous fiber reinforced vane and short fiber reinforced shrouds. The vane and shrouds were integrated into one piece segment. A three-step fabrication process consisting of a preforming process for the vane/shroud, and a fusion bonding process for integration, has been developed. The fusion bonding process has two advantages: it is cost-effective, and there is only slight misalignment of the continuous fiber. High-temperature thermoplastic polyimide was used for matrix resin.

The segment was successfully formed into the design shape. Static strengths of the vane segments were evaluated with a bending test. The results showed the strength of the vane segment to be sufficient for aerodynamic loading.
Author (AIAA)
Carbon Fiber Reinforced Plastics; Stators; Vanes; Gas Turbines

19980057171

Aircraft engine materials - Recent trends and future directions

Williams, J. C., GE Aircraft Engines, USA; 1997, pp. 1153-1158; In English; Copyright; Avail: Aeroplus Dispatch

Aircraft engines have exhibited continuous improvement both in performance and in reliability over the past three decades. There are several key performance parameters, such as thrust to weight, compressor exit temperature and turbine inlet temperature, that characterize this improvement. Better materials and processes have contributed to this improvement. This paper summarizes some of the materials- and process-related improvements. As the aircraft engine matures, the opportunities for sustained improvement are fewer and cost is becoming increasingly important. The paper discusses these issues and identifies some remaining opportunities for further improvement. It also describes the additional constraints that cost will place on realizing these. The paper closes by speculating about some of the highest pay-off areas for engine materials and process R&D and outlines some of the barriers that must be overcome to reduce developments in these areas to practice.
Author (AIAA)
Aircraft Engines; Nickel Alloys; Heat Resistant Alloys; Reliability; Metal Matrix Composites; Ceramic Matrix Composites

19980057172

The development of ceramic matrix composite (CMC) for combustors of gas turbine engine

Nishio, Kozi, Kawasaki Heavy Industries, Ltd., Japan; Igashira, Ken-ichiroh, Kawasaki Heavy Industries, Ltd., Japan; Okazaki, Shozo, Kawasaki Heavy Industries, Ltd., Japan; 1997, pp. 1159-1164; In English; Copyright; Avail: Aeroplus Dispatch

In the aerospace and energy industries, there is a growing demand for advanced structural materials that are light-weight and can withstand temperatures above the melting point of metal. We studied the use of CMC materials as a combustor liner with the aim of developing the combustor, which is one of the components of a gas generator. We confirmed the appropriateness of using the selected silicon carbide fiber-reinforced silicon carbide (SiC/SiC) as the combustor liner through the process of selecting, trial-producing, and evaluating the characteristics of composite materials, and by performing thermal stress analysis of model CMC liners. In this paper, we describe the progress of technologies for producing, processing, and applying CMC.
Author (AIAA)
Ceramic Matrix Composites; Combustion Chambers; Gas Turbine Engines

19980057174

Application of advanced carbon-carbon composites to a tip turbine structure of the ATREX engine

Hatta, Hiroshi, Inst. of Space and Astronautical Science, Japan; Tanatsugu, Nobuhiro, Inst. of Space and Astronautical Science, Japan; Kogo, Yasuo, Tokyo, Science Univ., Japan; Ohnabe, Hisaichi, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Onozuka, Masakazu, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Tomioka, Fumiki, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; 1997, pp. 1171-1176; In English; Copyright; Avail: Aeroplus Dispatch

A feasibility study was carried out to apply carbon/carbon (C/C) composites to a turbine disk of the air-turbo-ram-jet engine. The optimum design of a turbine disk made of C/C composites was explored in two kinds of structures, i.e., monolithic and joined. The monolithic structure is to be composed of 3D reinforced fabrics, and the joined structure divided into three kinds of components. The joined structure is shown to be superior to the monolithic one because the optimum arrangement of the reinforcing fibers can be easily made in the joined structure.
Author (AIAA)
Carbon-Carbon Composites; Ramjet Engines

19980057180

Potential application of ceramic matrix composites to aero-engine components

Ohnabe, Hisaichi, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Masaki, Shoji, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Onozuka, Masakazu, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Miyahara, Kaoru, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Sasa, Tadashi, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; 1997, pp. 1541-1544; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the potential application of ceramic matrix composites to aero-engine components by reviewing the related published papers and our experiences in this field. It contains the material requirements for aero-engines, trends in aero-en-

gine materials use, Japanese projects associated with CMCs, and potential application of CMCs to aero-engines, such as combusters, nozzle flaps, and bladed disks. From the standpoint of application to aero-engines, the remaining R&D issues are reviewed briefly. Material development, particularly interface and fibers for high temperature, are discussed.
Author (AIAA)
Ceramic Matrix Composites; Aircraft Engines; Engine Parts; Jet Engines

19980057372
The effects of propeller tip vane on flow-field behavior
Watanabe, T., Fujitsu Labs., Ltd., Japan; Nigim, H. H., Birzeit Univ., Jordan; Koyama, H. S., Tokyo Denki Univ., Japan; Experiments in Fluids; Nov. 1997; ISSN 0723-4864; Volume 23, no. 5, pp. 410-417; In English; Copyright; Avail: Aeroplus Dispatch

This paper investigates the effects of attaching a tip vane to a propeller blade on the development and propagation of a tip vortex. The study employed a two-bladed propeller operating with and without a tip vane. Evaluation of the tip vortex was studied by using both smoke-wire flow visualization, hot wire anemometer, and strain gauge load-cell techniques. The mean velocity distributions and the velocity unsteadiness data as well as thrust, input power, and efficiencies were obtained. Experiments were repeated at various rotating speeds ranging from 2000 to 5000 rpm.
Author (AIAA)
Propeller Blades; Blade Tips; Tip Vanes; Cascade Flow; Vortices; Flow Visualization

19980057824
Initial engine relight test on Eurofighter 2000
Bragagnolo, N., Alenia Aeronautica, Italy; Ferretti, A., Alenia Aeronautica, Italy; Venanzetti, M., Italian Air Force, Italy; 1997, pp. 211-231; In English; Copyright; Avail: Aeroplus Dispatch

The integration of the new EJ200 engine into the Eurofighter 2000 aircraft is discussed. The basic architecture of the engine's secondary power system is shown and an additional power unit (APU) supplied in the aircraft in case of double engine failure is examined. Modifications that have been made to the aircraft to support operation of the APU in flight are described. Engine relight procedures are presented and flight test results are reported along with lessons learned.
AIAA
Aircraft Engines; Engine Tests; Engine Design; Auxiliary Power Sources; Engine Failure

19980057825
Automatic VMC protection in the C-130J
Schaefer, Lyle H., Lockheed Martin Aeronautical Systems, USA; Roberts, Wayne, Lockheed Martin Aeronautical Systems, USA; 1997, pp. 235-252; In English; Copyright; Avail: Aeroplus Dispatch

The C-130J possesses an Automatic Thrust Control System (ATCS) which has demonstrated its ability to essentially eliminate VMC from a simulated or actual outboard engine failure as a safety consideration for virtually all conditions on takeoff, wave-off, or up and away operations. This paper explains how this ATCS system functions and how it was developed. It defines the contribution the system makes to both performance and safety.
Author (AIAA)
C-130 Aircraft; Thrust Control; Flight Safety; Automatic Control; Engine Failure; Control Systems Design

19980058200
Turbine blade tip/outer airseal/platform flow analysis
Hah, C., NASA Lewis Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

These notes present an overview of the interaction between the main-passage flow through a high-pressure turbine and secondary flows due to leakage through wheelspace rim seals. First, various experimental and analytical studies of wheelspace-rim-seal flows and their interaction with turbine main-passage flows are reviewed. A recent numerical study of the interaction between a turbine main-passage flow and a wheelspace-cavity-seal flow is described. Two different numerical approaches are used in the numerical study: a structured-grid method is used to study the overall interaction between the turbine stage components and the wheelspace-cavity-seal flow, and an unstructured-grid method is used to resolve the detailed flow features within the geometrically complex cavity seal. The numerical results agree with various observations from experimental studies under similar flow conditions. As the flow rate through the rim cavity seal is increased, the ingestion of fluid from the main-passage flow into the rim seal area decreases drastically.
Author (AIAA)
Secondary Flow; Axial Flow Turbines; Turbine Blades; Blade Tips; Interactional Aerodynamics

19980058289

The analysis of airbreathing propulsion system/vehicle integration for aerospace plane

Wang, Zhanxue, Northwestern Polytechnical Univ., China; Tu, Qiuye, Northwestern Polytechnical Univ., China; Chen, Yuchun, Northwestern Polytechnical Univ., China; Tang, Diyi, Northwestern Polytechnical Univ., China; Journal of Propulsion Technology; Dec. 1997; ISSN 1001-4055; Volume 18, no. 6, pp. 10-13; In Chinese; Copyright; Avail: Aeroplus Dispatch

The definition of the frame propulsion interface of an aerospace plane is introduced. Methods of designing propulsion systems and choosing geometric parameters are described. Using the chosen parameters, the performance of the propulsion system is calculated. The algorithm for determining the net thrust of an aerospace plane is given.

Author (AIAA)

Air Breathing Engines; Systems Integration; Aerospace Planes; Space Transportation System; Spacecraft Propulsion; Aircraft Engines

19980058300

An investigation on the technique of flutter failure diagnosis of the turbojet engine for missile

Sun, Yang, China Aerospace Corp., 31st Research Inst., Beijing, China; Journal of Propulsion Technology; Dec. 1997; ISSN 1001-4055; Volume 18, no. 6, pp. 60-63; In Chinese; Copyright; Avail: Aeroplus Dispatch

The fundamental theory of flutter diagnosis is described. Several vibration fault examples of missile turbojet engines are introduced. This paper designs a system for vibration fault diagnosis of missile turbojet engines. Finally, this paper discusses the method for vibration fault diagnosis of missile turbojet engines.

Author (AIAA)

Turbojet Engines; Missiles; Flutter Analysis; Failure Analysis; Structural Vibration

19980058301

A method of the design load spectrum derivation for trainer engine

Song, Yingdong, Nanjing Univ. of Aeronautics and Astronautics, China; Journal of Propulsion Technology; Dec. 1997; ISSN 1001-4055; Volume 18, no. 6, pp. 64-67; In Chinese; Copyright; Avail: Aeroplus Dispatch

The method of load spectrum derivation for trainer engine design is presented. The main steps are: selecting reference aircraft engine, measuring active engine load spectrum, predicting new engine flight mission profiles, and drawing up design duty cycles of the new engine. As a general method, it can be used for other typical engines to a certain extent.

Author (AIAA)

Training Aircraft; Aircraft Engines; Engine Design

19980058410

Experimental setup, measurement and analysis of the onset of compressor flow instabilities in an aeroengine

Hoess, Bernd, Muenchen, Univ. der Bundeswehr, Germany; Fottner, Leonhard, Muenchen, Univ. der Bundeswehr, Germany; 1997, pp. 117-131; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the experimental setup, measurements, and different analysis techniques of highly unsteady pressure signals during the onset process of compressor flow instabilities in the two-spool bypass aeroengine LARZAC 04 at various power settings. Several analysis techniques, such as temporal low-pass and band-pass filtering, temporal and spatial Fourier transform, and a wavelet analysis technique, are applied. While filtering and the Fourier spectrum give good insight into the physical background of the stall inception process - but with very little warning time - the wavelet frequency spectrum indicates the approach of the stalling process a few hundred rotor revolutions in advance independently of the type of precursor. Depending on the rotor speed, three different types of stall inception processes were observed within the low-pressure compressor. While at low speed stall originates from spike-type precursors, long wavy pressure fluctuations corresponding to modal waves were observed prior to stall at midspeed. At high speed rotor shaft unbalancing dominates the stall inception process as an external forcing function.

Author (AIAA)

Aircraft Engines; Flow Stability; Compressors; Flow Measurement; Rotating Stalls

19980058934

3D numerical simulation of supersonic reacting flows in scramjet combustor

Liang, Jianhan, Natl. Univ. of Defence Technology, China; Wang, Chengyao; Pan Tao Ti Hsueh Pao/Chinese Journal of Semiconductors; May, 1997; ISSN 0253-4177; Volume 18, no. 5, pp. 1-4, 13; In Chinese; Copyright; Avail: Issuing Activity

A three dimensional numerical code has been developed to simulate supersonic reacting flows in scramjet combustor. An implicit, finite volume, Lower-Upper (LU) and time-marching method was employed in the code to solve the complete Navier-

Stokes and species equations in a fully coupled and efficient manner. An upwind flux split method named AUSM was adopted to get crisp representations of shock and discontinuities. A global chemistry model was used to simulate the chemical reaction of hydrogen and air. The Baldwin-Lomax algebraic turbulence model was used to enclose the governing equations. To testify the reliability of the code, the numerical results were compared with available experimental data.
Author (revised by EI)
Combustion Chambers; Reacting Flow; Supersonic Combustion; Supersonic Combustion Ramjet Engines; Supersonic Flow; Ramjet Engines; Reaction Kinetics; Combustion; Finite Volume Method

19980060327

Reliability analysis of a single-engine aircraft FADEC

Hjelmgren, Klas, Chalmers Univ. of Technology, Sweden; Svensson, Sven, Chalmers Univ. of Technology, Sweden; Hannius, Olof, Volvo Aero Corp., Sweden; 1998, pp. 401-407; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a reliability analysis of two options to a fault-tolerant Full Authority Digital Electronic Control system (FADEC) intended for control of an aircraft gas turbine engine. The study concentrates on an application for an aircraft equipped with a single engine, thus placing very hard constraints on the reliability of the FADEC. The analysis is based on Markov modeling and a method of mapping state probabilities. Using this method, the influence of varying criticality among the flight mission phases can be investigated, as can the influence of not using the common assumption of 'perfect from start'. The study shows that latent/hulls, together with incomplete repair between flights (i.e., the system is not perfect from start) have a clear influence on the assessed reliability. How important these faults are depends to a great extent on the probability of repair. The study also indicates that phase modeling is of less importance, mainly because the phases are quite similar in the specific model and the assumed flight mission time is fairly short compared to MTTF for the components of the FADEC.
Author (AIAA)
Aircraft Engines; Reliability Analysis; Engine Failure; Markov Processes; Engine Control; Fault Tolerance

19980062349

New compressor for GE90 engine

Kandebo, Stanley W., USA; Aviation Week & Space Technology; Feb. 02, 1998; ISSN 0005-2175; Volume 14, no. 5, pp. 40; In English; Copyright; Avail: Aeroplus Dispatch

General Electric's plans to develop, flight test, and certify, by the end of this year, an increased efficiency compressor for its GE90 family of engines are briefly reviewed. The new compressor will maintain the unit's inner and outer flowpaths, but blades and vanes in the first 10 stages will be reprofiled using 3D aerodynamic codes. It is expected that the compressor's efficiency can be improved by 1.5-2 percent, with an increase in the exhaust gas temperature margins by about 20 C.
AIAA
Compressors; Aircraft Engines

19980062356

Propelling changes

Norris, Guy, USA; Flight International; Nov. 05, 1997; ISSN 0015-3710; Volume 152,, no. 4599, pp. 35-37; In English; Copyright; Avail: Aeroplus Dispatch

The goals, technology, and applications of the U.S. Integrated High Performance Turbine Engine Technology (IHPTET) program are briefly reviewed. The main focus of the program, which is a joint effort of the U.S. Air Force, Navy, and Army, NASA, the Defence Advanced Research Projects Agency, and industry, is on the development of more affordable, more robust, higher-performance turbine engines. Some of the changes made in the original goals and applications of the program are discussed.
AIAA
Turbine Engines; Research and Development; Aircraft Engines

19980062399

Integration of the SMR-95 engine in the Dassault Mirage F1AZ

Barker, D. E., South African Air Force, Test Flight and Development Centre, South Africa; Cockpit; Dec. 1997; ISSN 0742-1508, pp. 6-11; In English; Copyright; Avail: Aeroplus Dispatch

The SMR-95, a derivative of the Klimov RD-33 engine fitted to the MiG-29, was presented for integration on the South African Air Force (SAAF) Mirage F1AZ to improve the combat performance of the aircraft. The modified engine was developed as a joint venture between several South African and Russian aerospace companies. The successful integration of the engine gave

rise to a new model of the Mirage F1AZ in the SAAF, the Super Mirage F1. Here, some of the more interesting aspects of the the integration flight test program are briefly reviewed.
AIAA
Aircraft Engines; Engine Airframe Integration; Mirage Aircraft; Aircraft Performance

19980063001

Transient responses of blades to bird impact coupled with deformations of blade

Chen, Wei, Nanjing Univ. of Aeronautics and Astronautics, China; Qi, Wenkai, Nanjing Univ. of Aeronautics and Astronautics, China; Cao, Deping, Nanjing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 93-95; In Chinese; Copyright; Avail: Aeroplus Dispatch

It is necessery to calculate the transient responses of blades precisely in analysis of blade damage due to bird impact. Because the deformations of blade can influence the distribution and magnitudes of bird impact loads, the coupling of the bird impact with blade deformation has a large influence on the transient responses of the blade. A simple and effective method is provided to analyze the responses of blades in consideration of this coupling. Taking a model blade as an example, its influence's extent is also determined.
Author (AIAA)
Aircraft Engines; Turbine Blades; Bird-Aircraft Collisions; Transient Response; Impact Loads; Damage Assessment

19980063031

Aeroelastic tailoring for rotor blades of transonic swept fans

Zhou, Sheng, Beijing Univ. of Aeronautics and Astronautics, China; Yuan, Wei, Beijing Univ. of Aeronautics and Astronautics, China; Guo, Enmin, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 1-6; In Chinese; Copyright; Avail: Aeroplus Dispatch

In order to raise fan stage pressure, as an important measure to enhance engine thrust/weight ratio, there are two restrictive factors; first, the increase of rotor tip speed will strengthen the shock waves in rotor passages, which decrease the efficiency. The strengthened shock waves could induce the onset of stall flutter. For turbofans with small bypass ratio, stall flutter is the main aeroelastic instability in transonic fans. Both the abovementioned restrictive factors for raising the stage pressure ratio are correlated closely with the 3D shock wave structure and the large-scale separation zone induced by 3D interaction of the shock wave with the boundary layer. However, the 3D shock wave structure inside rotor passages is correlated with the spatial curve of the rotor blade leading edge. Designing the curve of blade leading edge therefore becomes an important problem of turbomachine aerodynamics. During design process of some modern transonic swept fans, a kind of integrated aerodynamic/aeroelastic tailoring program has been used. The aeroelastic tailoring is described, and an illustrative example is shown.
Author (AIAA)
Turbofan Engines; Rotor Blades; Aeroelasticity; Transonic Flutter; Thrust-Weight Ratio; Tip Speed

19980063043

Adaptive rectification of parameters in aeroengine simulation model

Xie, Guanghua, Northwestern Polytechnical Univ., China; Zeng, Qingfu, Northwestern Polytechnical Univ., China; Zhang, Yandong, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 37-40; In Chinese; Copyright; Avail: Aeroplus Dispatch

An adaptive simulation model has been developed by means of modification factors. A modified conjugate gradient algorithm is employed for solving the nonlinear programming problem in the model. According to the parameter measurements of the engine on a test rig and in flight, the component characteristics of the engine are rectified by the adaptive model; as a result, outputs of the model are in accordance with the measurements. As an example, the method provided was adopted to rectify the parameters in the simulation model of a given twin-spool, reheated turbojet engine, and the simulation achieved satisfactory accuracy.
Author (AIAA)
Aircraft Engines; Nonlinear Programming; Engine Tests; Adaptive Control; Flight Tests; Turbojet Engines

19980063046

An acceleration adaptive control for turboshaft engine of helicopter

Hu, Shimin, Nanjing Univ. of Aeronautics and Astronautics, China; Xu, Dongsheng, Nanjing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 45-48; In Chinese; Copyright; Avail: Aeroplus Dispatch

A scheme for acceleration adaptive fuel control is put forward for a helicopter turboshaft engine. The scheme is based on N(GG)/P2 closed-loop control with adaptive control rule, which corrects the demand of N(og)/P2 closed-loop control PID with surge flag that is detected by a sensed compressor discharge pressure during engine acceleration. Engine performance deterioration or damage will initiate the surge in this time interval. This scheme also provides altitude compensation and surge recovery P2. The hardware of an existing FADEC requires some modification, but mainly the fuel control microcomputer software, so it is easy to upgrade an existing FADEC to the adaptive-control level.
Author (AIAA)
Helicopter Engines; Fuel Control; Turboshafts; Adaptive Control; Power Efficiency; Proportional Control

19980063048

Thrust-vectoring nozzle math model

Liu, Xiaoyong, Northwestern Polytechnical Univ., China; Fan, Siqi, Northwestern Polytechnical Univ., China; Chen, Fuqun, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 49-52; In Chinese; Copyright; Avail: Aeroplus Dispatch

A thrust-vectoring nozzle-modeling method is developed by means of the Finite Volume Method (FVM) and back-propagation neural networks. The neural networks learning samples are the results of the FVM computation. The obtained model describes the functions of the nozzle thrust, thrust coefficient and vectoring angle to the inlet, exit and structural parameters of the nozzle. The model is of great significance for researching vectoring nozzle control law and integrated flight/propulsion control. The investigation shows that the deviations among the output of the model, the results of FVM computation, and the test data are quite small.
Author (AIAA)
Jet Nozzles; Thrust Vector Control; Finite Element Method; Neural Nets; Finite Volume Method; Inlet Nozzles

19980064862

Validation of a one-dimensional, steady, infinite-rate model for gas-turbine combustors

Rodriguez, Carlos G., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; O'Brien, Walter F., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1068; Copyright; Avail: Aeroplus Dispatch

A one-dimensional numerical model has been developed for the analysis of complete gas-turbine combustor configurations. It is based on the solution of the integral form of the Euler equations with sources. These equations include the conservation equation for a mixture-fraction variable, which allows the determination of the composition of the mixture at any point. As a result, the heat-release from combustion is automatically given as part of the solution. The method is applied to a production burner, and the results compared with those from an industrial one-dimensional burner code. Agreement between both methods is good, providing a validation for the present model.
Author (AIAA)
Proving; Gas Turbines; Combustion Chambers; Mathematical Models; Computational Fluid Dynamics

19980065111

Numerical and experimental study on precompression effect for hypersonic vehicle

Kobayashi, Hiroaki, Tokyo, Univ., Japan; 1997, pp. 51-60; In English
Report No.(s): AAS Paper 97-404; Copyright; Avail: Aeroplus Dispatch

Precompression effects due to forebody nose shape and the geometrical arrangement of the intake underneath the fuselage of a hypersonic vehicle are analyzed by CFD calculation using 3D compressive Navier-Stokes equations. The results are verified by wind tunnel tests.
Author (AIAA)
Hypersonic Vehicles; Forebodies; Compression Loads; Propulsion System Performance; Air Intakes; Air Breathing Engines; Engine Design

19980065370

Comparison of physical and aerodynamic ramps as fuel injectors in supersonic flow

Fuller, Raymond P., Taitech, Inc., USA; Wu, Pei-Kuan, Taitech, Inc., USA; Nejad, Abdollah S., USAF, Research Lab., USA; Schetz, Joseph A., Virginia Polytechnic Inst. and State Univ., Blacksburg; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 135-145; In English
Contract(s)/Grant(s): F33615-93-C-2300; F33615-96-C-2625; Copyright; Avail: Aeroplus Dispatch

An experimental investigation was conducted to compare the supersonic mixing performance of a novel flush-wall aerodynamic ramp injector with that of a physical ramp injector. The aerodynamic ramp injector consists of nine flush-wall jets arranged to produce fuel-vortex interactions for mixing enhancement in a supersonic crossflow. Test conditions included a Mach 2.0 crossflow of air with a Reynolds number of 3.63 x 10 exp 7 per meter and helium injection with jet-to-freestream momentum flux ratios of 1.0 and 2.0. Conventional probing techniques, including species composition sampling, were employed to interrogate the flow field at several downstream locations. Results show that, with increasing jet momentum, the aeroramp exhibited a significant increase in fuel penetration, whereas the physical ramp showed no discernible change. The near-field mixing of the aeroramp was superior to that of the physical ramp; however, the physical ramp reaches a fully mixed condition at approximately half the distance of the aeroramp. As the jet momentum was increased, the far-field mixing performance of the aeroramp approached that of the physical ramp. In all cases the total pressure loss incurred with the aeroramp was less than that caused by the physical ramp. For both injectors the total pressure loss decreased with increasing jet momentum. It was concluded that, although physical ramps may provide better far-field mixing, properly designed flush-wall injection can provide comparable mixing performance while avoiding the practical problems associated with an intrusive geometry in a scram jet combustor.
Author (AIAA)
Supersonic Flow; Fuel Injection; Injectors; Jet Mixing Flow

19980065386

Preliminary estimation of engine gas-flow-path size and weight

Sanghi, Vivek, Gas Turbine Research Establishment, India; Kumar, Kishore, Gas Turbine Research Establishment, India; Sundararajan, V., Gas Turbine Research Establishment, India; Sane, S. K., Indian Inst. of Technology, India; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 208-214; In English; Copyright; Avail: Aeroplus Dispatch

Subsequent to identifying the optimum engine cycle over a specified baseline design mission, one of the important goals of conceptual design is to translate this into an aerothermomechanically compatible gas-flow-path (GFP) layout and weight estimation. Engine GFP size and weight definition are important design parameters. They define the starting point for detailed component design and the physical limits for integration of the engine with the airframe. This paper describes the mathematical basis of engine GFP sizing and weight estimation, as well as their computer simulation, validation, and application to an optimum engine cycle, which will be typical of the next generation of combat aircraft.
Author (AIAA)
Aircraft Engines; Gas Turbine Engines; Engine Design; Weight (Mass); Size (Dimensions)

19980065394

Aerodynamics performance prediction of thrust-vectoring nozzles

Matesanz, A., SENER, Spain; Velazquez, A., SENER, Spain; Rodriguez, M., SENER, Spain; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 241-246; In English; Copyright; Avail: Aeroplus Dispatch

This paper deals with a study that has been undertaken to analyze the aerodynamics performance of thrust-vectoring nozzles frmn an engineering design point of view. The rationale for the study is the existence of a trend within the aeronautics industry to provide fighter aircraft with thrust-deflection capabilities. Regarding practical design, and taking into account the fact that these nozzles have additional degrees of freedom, efficient prediction methodologies are needed to analyze the aerodynamics behavior associated with the many combinations of parameters that characterize these propulsive devices. The methodology presented is based on a combination of theoretical analysis and computational fluid dynamics in such a way that numerical simulation provides data which, after some theoretical work, are shaped in the fashion of generic design curves ready for use with practical problems. Details of the flow solver as well as a summary of its validation campaign are also provided.
Author (AIAA)
Nozzle Design; Thrust Vector Control; Aerodynamic Characteristics; Nozzle Thrust Coefficients

19980067068

Semi-physical electric simulation of aeroengine digital control system

Ye, Zhifeng, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Daobo, Nanjing Univ. of Aeronautics and Astronautics, China; Cheng, Lan, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1005-2615; Volume 29, no. 4, pp. 435-438; In Chinese; Copyright; Avail: Aeroplus Dispatch

A closed-loop semiphysical simulating system has been presented in this paper by use of a digital controller and real-time mathematical model of an aircraft engine. Some sensor signals and characteristics of a hydraulic device for fuel feeding and a

nozzle-control device are simulated by an electrical circuit. The system can run in real-time. It may be used to design a control law and control logic for an aircraft engine system. The simulation system has the advantages of economy and convenience.
Author (AIAA)
Aircraft Engines; Engine Control; Numerical Control; Computerized Simulation

19980067102

Recuperation of turbofan engine and its thermodynamic analysis

Cai, Ruixian, Chinese Academy of Sciences, Inst. of Engineering Thermophysics, China; Zhang, Shizheng, Chinese Academy of Sciences, Inst. of Engineering Thermophysics, China; Wang, Xu, Chinese Academy of Sciences, Inst. of Engineering Thermophysics, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 337-340; In Chinese; Copyright; Avail: Aeroplus Dispatch

A novel method for modifying a turbofan aeroengine into a land-base turboshaft engine was proposed by late Prof. C. H. Wu. In this case, the exhaust of hot core flow is used to recuperate the bypass flow, therefore, it is not necessary to redesign the low pressure compressor (fan) and the low pressure turbine. A comprehensive thermodynamic analysis is given to study the applicable range and results of this proposal. It is found that such a modification is suitable for turbofan engines with a bypass ratio approximately equal to 1. The optimum total pressure ratio for efficiency is rather low and close to the optimum pressure ratio of a pure gas turbine for specific output. The obtainable system efficiency and power can be higher than those obtainable with the conventional modification method (cutting the top of fan blade) by about 10 percent.
Author (AIAA)
Turbofan Engines; Thermodynamic Cycles; Turboshafts; Pressure Ratio; Specific Heat

19980067104

A two-phase afterburner combustion model

Zhu, Zuojin, Univ. of Science and Technology of China, Hefei, China; Chen, Yiliang, Univ. of Science and Technology of China, Hefei; Zhang, Xiaochun, Shenyang Aeroengine Research Inst., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 345-349; In Chinese; Copyright; Avail: Aeroplus Dispatch

According to the fundamental concept of two fluids, governing equations for the description of gas-droplets turbulent combustion in an afterburner of a jet engine are formulated in which the important injection effect of the droplets in the afterburner is considered in detail. The Farve average method is employed to represent the effects of turbulent combustion in the afterburner. The multiple time scale turbulent k-epsilon model proposed by Kim is applied to calculate the eddy viscosity of the turbulent field. The heat flux radiation model is used to consider the effect of radiation at high temperature; a simple one-step chemical reaction model is used to approximate the combustion of kerosene. The chemical reaction rate is assumed to be controlled by the eddy break-up process, and the reaction rate is modified by a premixed reaction model in Arrhenius form. The application of the SIMPLE algorithm indicates that the present two-fluid model can calculate two-phase turbulent combustion in the jet engine afterburner and obtain reasonable results.
Author (AIAA)
Aircraft Engines; Turbulent Combustion; Two Phase Flow; Afterburning; Two Fluid Models; K-Epsilon Turbulence Model

19980067105

Numerical simulation of combustor flows

Xu, Hang, Beijing Univ. of Aeronautics and Astronautics, China; Huang, Yang, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 350-352; In Chinese; Copyright; Avail: Aeroplus Dispatch

A method has been developed for the calculation of three-dimensional flows in aeroengine combustors including diffuser and flametube, inner and outer annuluses. A 3D body-fitting grid has been generated to deal with the complex geometry of the combustor. A nonstaged grid scheme and the k-epsilon turbulence model are adopted. The mass flowing through primary holes, dilution holes, and film cooling holes is calculated. The calculated results are consistent with the experimental measurements.
Author (AIAA)
Aircraft Engines; Combustion Chambers; Turbulent Combustion; Three Dimensional Flow; K-Epsilon Turbulence Model

19980067106

Aeroengine test automation of adaptive control with restraints

Fan, Ding, Northwestern Polytechnical Univ., China; Li, Runzhi, Southern Powerplant Machinery Corp., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 353-356; In Chinese; Copyright; Avail: Aeroplus Dispatch

An automatic control system for aeroengine tests has been designed based on the method of model reference adaptive control with constraints. According to the simulation results, this method has good adaptability when the controlled member contains nonlinear elements or the controller member varies over a wide range. The simulation results also show that the controlled system still has a satisfactory performance index by regulating the controller's parameters, even if the constraints are out of limits.
Author (AIAA)
Aircraft Engines; Automatic Control; Engine Tests; Model Reference Adaptive Control; Control Systems Design; Engine Control

19980067110

Near deadbeat control of an aeroengine speed simulation system

Sheng, Wanxing, Chinese Academy of Sciences, Inst. of Automation, China; Dai, Ruwei, Chinese Academy of Sciences, Inst. of Automation, China; Wang, Sun'an, Xian Jiaotong Univ., China; Shi, Weixiang, Xian Jiaotong Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 371-373; In Chinese; Copyright; Avail: Aeroplus Dispatch

The near deadbeat control design was applied to an aeroengine speed simulation system for flight handling simulation. The high power demand of the aeroengine speed simulation system can be met by adopting a type of electrohydraulic pump controlled motor system. But the desired dynamic properties are difficult to obtain under the condition of a large step imput amplitude. According to the idea of deadbeat control, a method of quasi-deadbeat control design is proposed to overcome the difficulty. The experiments demonstrate the effectiveness of the presented design.
Author (AIAA)
Aircraft Engines; Aircraft Hydraulic Systems; Engine Control; Speed Control; Flight Simulation; Control Systems Design

19980067115

Measurement and determination of aeroengine thrust

Du, Heling, Chinese Gas Turbine Establishment, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 389-392; In Chinese; Copyright; Avail: Aeroplus Dispatch

It is difficult to measure the flight thrust of an aeroengine directly. It is determined now from mathematical relationships between the flight thrust and physical quantities that can be measured directly. According to the definition and the expression of the thrust, as well as the conditions derived from them, a method of aeroengine thrust determination and a program are provided on the basis of engine part tests, model tests, engine ground test, altitude-simulation tests, and flight tests. At the same time, the important function of the altitude-simulation facility is also analyzed with respect to correct flight thrust determination.
Author (AIAA)
Aircraft Engines; Thrust Measurement; Engine Tests; Engine Parts; Ground Tests; Flight Tests

19980067121

Pressure and averaged thrust of a Pulsed Detonation Engine model

Fan, Wei, Northwestern Polytechnical Univ., China; Yan, Chuanjun, Northwestern Polytechnical Univ., China; He, Liming, Northwestern Polytechnical Univ., China; Wang, Linquan, Northwestern Polytechnical Univ., China; Lie, Hengren, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 410-412; In Chinese; Copyright; Avail: Aeroplus Dispatch

A model of a Pulsed Detonation Engine (PDE) has been constructed. Its pressure and averaged thrust were analyzed and calculated according to the detonation wave theory, and then were measured with two sensors in testing of the PDE model. A comparison of the calculated results with the measured data shows that the PDE model can produce the pulsed detonation wave and thrust.
Author (AIAA)
Pressure Oscillations; Thrust Measurement; Partial Differential Equations

19980067123

Development of failure diagnosis techniques in engine digital control systems

Huang, Xianghua, Nanjing Univ. of Aeronautics and Astronautics, China; Sun, Jianguo, Nanjing Univ. of Aeronautics and Astronautics, China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 416-418; In Chinese; Copyright; Avail: Aeroplus Dispatch

This paper surveys the development of sensor failure diagnosis in engine digital control systems. First, the early research on techniques of sensor failure detection and isolation are reviewed. The main disadvantage of model-based methods is high sensitivity to modeling errors which are inevitable because of the complexity of the aircraft engine. Then the paper considers the necessity of robust failure diagnosis and its development. In view of the fact that the neural networks have been successively applied to

control realm and possess a tremendous potential, neural-network-based failure diagnosis is recommended as a promising approach for engine digital control systems.
Author (AIAA)
Aircraft Engines; Engine Failure; Numerical Control; Neural Nets

19980067174

Measurement of hypersonic flow fields around a sidewall compression scramjet inlet using shock tunnel experiments

Ito, Takeshi, National Aerospace Lab., Japan; Yamazaki, Takashi, National Aerospace Lab., Japan; Nakakita, Kazuyuki, National Aerospace Lab., Japan; Japan Society for Aeronautical and Space Sciences, Transactions; Nov. 1997; ISSN 0549-3811; Volume 40,, no. 129, pp. 196-206; In English; Copyright; Avail: Aeroplus Dispatch

Towards elucidating the aerodynamic forces produced by the spillage flow field around the lower inlet area of a sidewall compression type scramjet inlet, model experiments were carried out in the middle-scale shock tunnel of the National Aerospace Laboratory, Japan. Pitot pressure measurements at hypersonic flow speeds were obtained of (1) the boundary layer which develops on the under surface of the forebody directly upstream of the inlet entrance and (2) the spillage flow field directly under the throat area. In addition, the effects of the contraction ratio (CR), sidewall height, and forebody on the inlet were investigated. In good agreement with calculated results, the entering boundary layer was found to have a thickness from 3 to 6 mm. Similarly, the spillage flow field showed pressure peaks and dips that shifted away from the throat inlet and the peaks got larger in the lateral direction with an increase in CR from 4 to 12. The presence of the forebody and a decrease in sidewall height, respectively, produced an effect similar to that due to an increase in CR.
Author (AIAA)
Flow Measurement; Hypersonic Flow; Supersonic Combustion Ramjet Engines; Shock Tunnels; Aerodynamic Forces; Engine Inlets

19980067354

Control of flame-holding in supersonic airflow by secondary air injection

Takahashi, Shuhei, Tokyo, Univ., Japan; Sato, Naohiro, Tokyo, Univ., Japan; Tsue, Mitsuhiro, Tokyo, Univ., Japan; Kono, Michikata, Tokyo, Univ., Japan; Nakamura, Masahiko, Nihon Univ., Japan; Kondo, Hiroshi, Nihon Univ., Japan; Ujiie, Yasushige, Nihon Univ., Japan; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 18-23; In English
Report No.(s): AIAA Paper 96-4585; Copyright; Avail: Aeroplus Dispatch

Active control tests were performed to improve flame-holding in a fixed-geometry rectangular scramjet combustor at an off-design point and to improve self-ignition in the combustor. Eight air injectors were installed in the combustor wall, and secondary air was injected into the boundary layer, which developed downstream of a step that controlled the effective cross-sectional area of the combustor. Signals from pressure transducers on the combustor wall were used as feedback signals for the control. This control system was simple to install in a fixed-geometry combustor. The control system was effective in improving combustion oscillation and/or blowoff at an off-design point and was responsive to a rapid condition change. It was also valid for improving the self-ignition limit.
Author (AIAA)
Flame Holders; Gas Injection; Air Flow; Combustion Control; Active Control; Supersonic Combustion Ramjet Engines; Supersonic Flow

19980067362

Digital simulator for steady-state performance prediction of military turbofan engine

Sanghi, Vivek, Gas Turbine Research Establishment, India; Lakshmanan, B. K., Gas Turbine Research Establishment, India; Sundararajan, V., Gas Turbine Research Establishment, India; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 74-81; In English; Copyright; Avail: Aeroplus Dispatch

The significance of propulsion system steady-state performance prediction is identified. Digital simulation techniques have been described for steady-state performance prediction, with component maps and a controller. In addition to performance prediction, the application of a simulation code has been demonstrated to an engine cycle redesigning case study without major modifications in already existing hardware. As per the current military application trends, the twin-spool turbofan with a mixed exhaust has been chosen as the propulsion concept. The proposed formulation can easily be modified to simulate the steady-state performance of the twin-spool turbojet engine and also to generate the control schedules in the early design stage.
Author (AIAA)
Performance Prediction; Turbofan Engines; Military Aircraft; Digital Simulation; Steady State

19980067363

Influence of inlet pressure distortion on a convertible engine fan

Kaya, Tarik, International Space Univ., France; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 82-89; In English; Copyright; Avail: Aeroplus Dispatch

An experimental and computational study of the flow field of a fan with uniform and distorted inlet flow is presented. The research facility is a full-scale integrated engine with a constant-speed turbofan. The blade-incidence angles of the fan-rotor can be changed during the operation. Thrust variation is thus achieved by altering the incidence of the fan-rotor blades in the same manner as a variable-pitch propeller. The flow field of the fan with a uniform inlet flow was studied by a quasi-3D approach based on a radial-equilibrium method. The radial-equilibrium solutions are within 1.5-10 percent of experimental measurements. The results indicated the stable operating range of the fan as a function of the rotor-blade-incidence angles. The results obtained with the uniform inlet flow were used as a reference basis for the study of the distorted inlet flow. The small-perturbation method was very useful to design the distortion screens and to study the propagation characteristic of the distortion. The results revealed that the fan attenuation capacity is augmented when the fan load increases. The distribution of the periodic and random velocity fluctuations at the rotor inlet and outlet was obtained by hot-film probes hy using an ensemble-averaging technique.

Author (AIAA)

Inlet Pressure; Flow Distribution; Dynamic Response; Pressure Effects; Flow Distortion; Convertible Fan-Shaft Engines; Turbofan Engines

19980067365

Method for noise suppressing nozzle calculation and first results of its implementation

Bosniakov, S., TsAGI, Russia; Fonov, S., TsAGI, Russia; Jitenev, V., TsAGI, Russia; Shenkin, A., TsAGI, Russia; Vlasenko, V., TsAGI, Russia; Yatskevich, N., TsAGI, Russia; Journal of Propulsion and Power; Feb. 1998; ISSN 0748-4658; Volume 14, no. 1, pp. 101-109; In English; Copyright; Avail: Aeroplus Dispatch

A description of a method for determining the flow field in a noise suppressing nozzle is presented. The method is formulated for the Favre-averaged Navier-Stokes equations. It is based on an explicit monotone second-order approximation, Godunov-type numerical scheme. The first set of calculations is made without turbulent and molecular viscosity being taken into account, and shows that the Euler approach allows the main features of the complicated flow in the mixer-ejector nozzle to be described. Special experiments confirm this idea and elucidate the exactness of CFD results.

Author (AIAA)

Noise Reduction; Flow Distribution; Nozzle Flow; Jet Aircraft Noise

19980067602

Little big fan

Norris, Guy, UK; Flight International; Sep. 30, 1997; ISSN 0015-3710; Volume 152,, no. 4593, pp. 51-55; In English; Copyright; Avail: Aeroplus Dispatch

The latest variant of the 20-year-old TFE731 geared turbofan engine for business aircraft has its basis in customer surveys conducted in 1991. Attention is given to the numerous refinements made in compressor and turbine airfoil fluid dynamics, superalloy materials incorporation, and auxiliary power unit design and capabilities.

AIAA

Turbofan Engines; Engine Design

19980068022

New power from Europe

Parker, Ian, UK; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 23-26; In English; Copyright; Avail: Aeroplus Dispatch

The MTU Turbomeca Rolls-Royce’s MTR390 helicopter engine is currently on the Eurocopter Tiger but has great potential in the re-engining market for aircraft that require up to 1000 kW or double that for twin-engine helicopters. This market is expected to expand further as the power grows to 1500 kW. The MTR390 offers low fuel consumption, high reliability, and low maintenance, and growth can occur in two jumps, the first increasing power by 20 percent and the second another 30 percent. The development and qualification of the MTR390 is described, and its excellent one-engine inoperative power rating is discussed. The on-condition monitoring carried out by the full authority digital engine control (FADEC) reduces maintenance time and costs. The MTR390 was designed and developed with the aid of computers, and its thorough testing program is described in this article.

The engine has demonstrated its ability to run on a wide variety of fuels. The MTR390's production phase and testing plans are outlined. Production of the engine for the Tiger attack helicopter is due to begin in 2000.
AIAA
Helicopter Engines; Modularity; Computer Aided Design; Engine Tests

19980068706

Inlet ramp regulating system with angle of attack

Wang, Hong, Northwestern Polytechnical Univ., China; Cai, Xiaobin, Northwestern Polytechnical Univ., China; Kang, Jichang, Northwestern Polytechnical Univ., China; 1997, pp. 290-295; In English; Copyright; Avail: Aeroplus Dispatch

For inlet ramp regulating systems of modern high-altitude and high-speed fighter aircraft, the regulating law of 'pi sub k +rho' is often used. However, this regulating law has several defects. In order to make inlets work better, a new kind of regulating method is proposed in this paper which uses the static pressure ratio of the compressor as the primary control parameter and the angle of attack as auxiliary control parameter. Simulation results indicate that the regulating method is feasible, and systems designed using the method are practical. This method is also beneficial for integrating flight control systems and propulsion control systems.
Author (AIAA)
Angle of Attack; Fighter Aircraft; Ramps (Structures); Flight Control; Aircraft Control; Flight Envelopes

19980068736

A calculating method of the spectrum of axial force acting on aeroengine rotor

Zhang, Wanren, Northwestern Polytechnical Univ., China; Lu, Wenlin, Northwestern Polytechnical Univ., China; 1997, pp. 456-459; In English; Copyright; Avail: Aeroplus Dispatch

The paper proposes a statistical method for various aerodynamic parameters under flying load spectra of different flight operations according to the linear-damage law of fatigue theory. The calculation results are adapted for research into the fatigue damage and life of aeroengine bearings. The crux of calculating the spectra of axial forces is to work out the aerodynamic parameters of the compressor under various working conditions. The method for calculating the above parameters according to the theory of 3D flow is investigated. This paper utilizes a model of the total losses and the lagging angle which is adapted for off-design operations in supersonic and transonic compressors. The distribution of the aerodynamic parameters in off-design operations can be worked out using the streamline curvature method. After the parameters are known, the rotor axial force of aeroengine rotors can be rather accurately worked out and the spectra of the axial forces on the bearings gained. The method can be used in researching bearings fatigue of aeroengines.
Author (AIAA)
Axial Loads; Aircraft Engines; Rotors; Damage; Fatigue Tests; Service Life

19980069059

Globally stabilizing controllers for multi-mode axial flow compressors via equilibria-dependent Lyapunov functions

Leonessa, Alexander, Georgia Inst. of Technology, Atlanta, USA; Chellaboina, Vijaya-Sekhar, Georgia Inst. of Technology, Atlanta; Haddad, Wassim M., Georgia Inst. of Technology, Atlanta; 1997, pp. 993-997; In English
Contract(s)/Grant(s): F49620-96-1-0125; DAAH04-96-1-0008; NSF ECS-94-96249; Copyright; Avail: Aeroplus Dispatch

We develop a multimode model for rotating stall and surge in axial flow compression systems that lends itself to the application of nonlinear control design. Using Liapunov stability theory, a novel nonlinear globally stabilizing control law based on equilibria-dependent Liapunov functions with converging domains of attraction is developed. The multimode model is used to show that the second and higher-order disturbance velocity potential harmonics in the flow equations strongly interact with the first harmonic during stall inception and must be accounted for in the control-system design processes.
Author (AIAA)
Controllers; Turbocompressors; Liapunov Functions; Control Systems Design

19980069060

Control of deep-hysteresis aeroengine compressors. I - A Moore-Greitzer type model

Wang, Hsin-Hsiung, Maryland, Univ., College Park, USA; Krstic, Miroslav, Maryland, Univ., College Park; Larsen, Michael, California, Univ., Santa Barbara; 1997, pp. 998-1002; In English
Contract(s)/Grant(s): F49620-96-1-0223; NSF ECS-95-1011-8461; Copyright; Avail: Aeroplus Dispatch

We study fundamental feedback control problems associated with deep-hysteresis compressors. We derive a modification of the Moore-Greitzer model which exhibits the right skew property. Our approach is based on representing the compressor characteristic as a convex combination of a usual cubic polynomial and a nonpolynomial term carefully chosen so that an entire family

of right-skew compressors can be spanned using a single parameter. We present bifurcation diagrams which show that our model matches experimental data well, in fact as closely as possible with a three-state Moore-Greitzer type ODE model.
Author (AIAA)
Aircraft Engines; Hysteresis; Mathematical Models; Turbocompressors; Systems Stability; Feedback Control

19980069061
Control of deep-hysteresis aeroengine compressors. II - Design of control laws
Krstic, Miroslav, Maryland, Univ., College Park, USA; Wang, Hsin-Hsiung, Maryland, Univ., College Park; 1997, pp. 1003-1007; In English
Contract(s)/Grant(s): F49620-96-1-0223; NSF ECS-95-1011-8461; Copyright; Avail: Aeroplus Dispatch
We continue the development of a methodology for control of deep-hysteresis compressors initiated in a companion paper. We develop a family of controllers which are applicable not only to the particular model presented before, but also to general Moore-Greitzer type models with arbitrary compressor characteristics. For each of our controllers we show that it achieves a supercritical (soft) bifurcation. We also address another key issue for control of rotating stall and surge - the limited actuator bandwidth. Our results show an interesting trade-off: as the actuator bandwidth decreases, the sensing requirements become more demanding.
Author (AIAA)
Aircraft Engines; Hysteresis; Turbocompressors; Control Systems Design; Mathematical Models; Feedback Control

19980069132
Bifurcation based nonlinear feedback control for rotating stall in axial flow compressors
Gu, Guoxiang, Louisiana State Univ., Baton Rouge, USA; Sparks, Andrew G., USAF, Wright Lab., USA; Banda, Siva S., USAF, Wright Lab., USA; 1997, pp. 1524-1528; In English
Contract(s)/Grant(s): F49620-94-1-0415; Copyright; Avail: Aeroplus Dispatch
Classical bifurcation analysis for nonlinear dynamics is used to derive a nonlinear feedback control law that eliminates the hysteresis loop associated with rotating stall and extends the stable operating range in axial flow compressors. The proposed control system employs pressure rise as output measurement and throttle position as actuating signal for which both sensor and actuator exist in the current configuration of axial flow compressors. Thus, our results provide a practical solution for rotating stall control in axial flow compressors.
Author (AIAA)
Branching (Mathematics); Feedback Control; Turbocompressors; Rotating Stalls; Aircraft Engines

19980069200
A neural network based Receding Horizon Optimal (RHO) controller
Long, Theresa W., NeuroDyne, Inc., USA; Hanzevack, Emil L., NeuroDyne, Inc., USA; Midwood, Brent R., NeuroDyne, Inc., USA; 1997, pp. 1994, 1995; In English; Copyright; Avail: Aeroplus Dispatch
A neural network based RHO controller is developed for jet aircraft engines. It takes advantage of the learning ability of the neural network to obtain the mapping function between system input and output and does not predicate upon a priori knowledge of the system model. The controller was tested using OREOX, a jet engine simulator provided by Pratt & Whitney. The controller recovers from system changes in seconds. Due to the smoothing and stability measures undertaken, the control trajectories are smooth and stable even when the target thrust is changed abruptly.
Author (AIAA)
Aircraft Engines; Neural Nets; Controllers; Engine Control

19980069402
Control of compressor rotating stall without distributed sensing using bifurcation stabilization
Sparks, Andrew, USAF, Wright Lab., USA; Gu, Guoxiang, Louisiana State Univ., Baton Rouge; 1997, pp. 3716-3720; In English; Copyright; Avail: Aeroplus Dispatch
Control of rotating stall in axial compressors is considered. A local bifurcation stabilization theorem using the projection method for the case of an uncontrollable, unobservable critical mode is described and extended to control laws that do not vanish at the critical or bifurcation point. This result is used to derive sufficient conditions for several control laws to guarantee that the subcritical pitchfork bifurcation of an axial compressor model is made supercritical so that the rotating stall hysteresis is eliminated. Each of the control laws considers operation at a set point distinct from the critical point and depends only on annulus-aver-

aged quantities as feedback variables to simplify sensing and signal processing requirements. A numerical example shows the transformation of the bifurcation from subcritical to supercritical and the elimination of the hysteresis region.
Author (AIAA)
Turbocompressors; Aerodynamic Stalling; Branching (Mathematics); Control Theory; Hysteresis; Feedback Control

19980069449
Deflection of turbofan exhaust streams for enhanced engine/nacelle integration
Tindell, R. H., Northrop Grumman Corp., USA; Marconi, F., Northrop Grumman Corp., USA; Kalkhoran, I., Polytechnic Univ., USA; Yetter, J., NASA Langley Research Center, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 106-112; In English; Copyright; Avail: Aeroplus Dispatch

An analytical and experimental description of how the fan exhaust of a modern turbofan can be deflected into an annular cascade using only core bleed flow is presented. Thrust reversing, emphasized herein, and/or vectoring is achieved without the need for fan duct blockers or other hardware devices to turn the flow, allowing lighter, less complex, and lower loss exhaust systems for more efficient up-and-away flight. Two approaches for deflecting fan flow into an annular cascade, using two different models, are described, and test results are discussed. Results of a Euler analysis, and its critical relationship with the testing are also described. Both methods use injected core flow to turn the fan flow. One method uses an annular air-curtain emanating from an annular injection slot located opposite the cascade and the other uses a similar slot in the nozzle throat to force upstream flow into the cascade. Both approaches are impacted by engine core bleed limits. Injector jet arrangements to meet this requirement while providing adequate reverse thrust are described; analyses and test results are reviewed.
Author (AIAA)
Thrust Reversal; Turbofan Engines; Engine Airframe Integration; Nacelles; Aircraft Engines; Jet Exhaust

19980069514
Engine fuel system design issues
Eder, Matthias, Pratt & Whitney, USA; 1997, pp. 61-64; In English; Copyright; Avail: Aeroplus Dispatch

In order to optimize the development of improved fire safe aviation fuels, it is necessary to understand how fuel is used in the engine prior to the combustion process. This paper discusses the utilization of fuel as a hydraulic fluid, a coolant, and a component lubricant in the aircraft engine prior to combustion. General fuel system design guidelines are provided to facilitate an understanding of fuel system architecture, system design requirements, and the flammability-related testing of fuel system components. Further discussions provide an insight into the type of components and materials used and the fuel properties considered in fuel system designs to ensure safe and reliable engine performance.
Author (AIAA)
Aircraft Fuel Systems; Systems Engineering; Aircraft Fuels; Flammability

19980069516
Aircraft fuel system design issues
Mehta, Harendra K., Boeing Co., USA; Peacock, A. T., Boeing Co., USA; 1997, pp. 73-78; In English; Copyright; Avail: Aeroplus Dispatch

This presentation is intended to provide an understanding of design considerations for the fuel system of a typical commercial aircraft, with an emphasis on safety. Current design methods to make the fuel systems as safe as possible are a culmination of technological advances combined with information from operational experience and accident investigations. The presentation briefly addresses past efforts to improve postcrash fire safety and concludes with recommendations for future research.
Author (AIAA)
Aircraft Fuel Systems; Systems Engineering; Commercial Aircraft; Safety Factors; Jet Aircraft; Fire Prevention

19980070157
Experimental determination of the effect of the scale factor on microturbine efficiency *Ehksperimental'noe opredelenie vliyaniya faktora masshtabnosti na kpd mikroturbin*
Matveev, V. N., Samarskij Gosudarstvennyj Aehrokosmicheskij Univ., Russia; Musatkin, N. F., Samarskij Gosudarstvennyj Aehrokosmicheskij Univ., Russia; Tikhonov, N. T., Samarskij Gosudarstvennyj Aehrokosmicheskij Univ., Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 65-69; In Russian; Copyright; Avail: Aeroplus Dispatch

The effect of the scale factor on the efficiency of three most frequently used types of microturbines (axial, centripetal with a closed rotor, and centripetal with a semiopen rotor) was investigated experimentally. It is found that, as the scale fractor decreases from 2.0 to 0.8, the efficiency decreases from 0.49 to 0.44 for axial microturbines, from 0.38 to 0.35 for centripetal microturbines

with a semiopen rotor, and from 0.415 to 0.380 for centripetal microturbines with a closed rotor. These results are explained by the fact that, as the scale factor decreases, the relative surface roughness of the blades increases, resulting in increased friction losses.
AIAA
Turbine Blades; Power Efficiency; Nozzle Geometry; Turbine Engines; Surface Roughness

19980070161

Simulation studies of the components of aviation gas turbine engines in the design of optimal test technologies ***Model'nye issledovaniya uzlov i agregatov aviatsionnykh GTD pri proektirovanii optimal'nykh tekhnologij ispytanij***

Adgamov, R. I., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Abzalov, A. R., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 93-97; In Russian; Copyright; Avail: Aeroplus Dispatch

An approach to the simulation studies of the components of gas turbine engines is examined as part of an effort aimed at the development of automated test processes. The first stage of the procedure proposed here involves an analysis of the design of an assembly and its operating conditions, identification of functionally complete subsystems, and definition of external and internal connections (with the engine, environment, and other components). The results are used to develop a functional block diagram of the test object. The block diagram is supplemented by numerical characteristics of the assembly, including statistical test data, and used for the development of a mathematical model. The mathematical model is then used to develop and optimize a test procedure for the particular assembly.
AIAA
Aircraft Engines; Engine Parts; Gas Turbine Engines; Engine Design; Engine Tests; Automatic Test Equipment

19980070227

The problem of the contactless electrostatic monitoring of the condition of aircraft engines - Theoretical and laboratory modeling ***Problema beskontaktnoj ehlektrostaticheskoj diagnostiki sostoyaniya avoatsionnykh dvigatelej - Teoreticheskoe i laboratornoe modelirovanie***

Vatazhin, A. B., Russia; Golentsov, D. A.; Likhter, V. A.; Shul'gin, V. I.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Apr. 1997; ISSN 0568-5281, no. 2, pp. 83-95; In Russian; Copyright; Avail: Aeroplus Dispatch

Electrogasdynamic test equipment has been developed which makes it possible to detect unsteady electrical fields generated in the vicinity of a turbulent jet by the charged particles of the jet. Regimes with continuous distributions of charged particles (where small particles are 'frozen' into the turbulent jet and 'track' turbulent fluctuations) and discrete regimes, where charged particles move in the form of clusters, have been reproduced. A probe theory for the detection of variable electric fields is developed and used to determine the temporal implementations of the probe signal for different charge distributions within the jet. The power spectra of signals detected by a probe are determined experimentally for turbulent jets with discretely and continuously distributed electrostatic charges.
AIAA
Jet Engines; Aircraft Engines; Electrostatic Probes; Nonintrusive Measurement; Engine Tests; Electric Field Strength

19980071341

Computational investigation of shock-enhanced mixing and combustion

Lee, Sang-Hyeon, Seoul National Univ., Republic of Korea; Jeung, In-Seuck, Seoul National Univ., Republic of Korea; Yoon, Youngbin, Seoul National Univ., Republic of Korea; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1813-1820; In English; Copyright; Avail: Aeroplus Dispatch

To understand the effects of the mixing process on the combustion process, the mixing characteristics of the reacting case are compared with those of the nonreacting case. Parametric studies varying the conditions of fuel injection are conducted to find the trends of the mixing and combustion processes. 3-D Navier-Stokes equations with a chemical reaction model and a k-omega turbulence model are used. The upwind method of Roe's flux difference splitting scheme is adopted. It is shown that the mixing process has a strong influence on the combustion process, whereas the combustion process does not have any significant effect on the mixing process. The combustion process is divided into two mixing regimes: a convection-dominated regime, where the burning rate increases with distance from the injection plane, and a diffusion-dominated regime as one moves downstream, where burning rate is constant. In the parametric studies, varying the fuel pressure with the fuel density held fixed makes little difference,

whereas varying the fuel density makes a significant difference in mixing rate and burning rate. A prediction of minimum combustor length for complete combustion is made.
Author (AIAA)
Shock Wave Interaction; Computational Fluid Dynamics; Mixing; Combustible Flow; Reacting Flow; Parameter Identification

19980071385
A method of calculating the thrust of pulsed detonation engines
He, Liming, Air Force Engineering College, China; Yan, Chuanjun, Northwestern Polytechnical Univ., China; Fan, Wei, Northwestern Polytechnical Univ., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 22-26; In Chinese; Copyright; Avail: Aeroplus Dispatch

Based on the analysis of the basic properties of detonation combustion and the operating principles of pulsed detonation engines, a calculation method for determining the thrust of pulsed detonation engines is established. The principal test model of pulsed detonation engines designed by the authors is used as an example for calculating the thrust of pulsed detonation engines, and the calculation results are in good agreement with experimental data.
Author (AIAA)
Thrust Measurement; Breadboard Models; Engine Tests

19980071388
Single phase combustion model and its application in a jet engine afterburner
Zhu, Zuojin, Univ. of Science and Technology of China, Hefei, China; Han, Bai, Univ. of Science and Technology of China, Hefei; Chen, Yiliang, Univ. of Science and Technology of China, Hefei; Zhang, Xiaochun, Shenyang Aeroengine Research Inst., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 36-40, 45; In Chinese; Copyright; Avail: Aeroplus Dispatch

A turbulent combustion model for an aeroengine afterburner is presented. Attention is paid to the important effects of fuel injection in an afterburner. By employing the multiple time scale turbulent k-epsilon model, the high temperature heat flux radiation model, and the SIMPLE algorithm, a numerical study of the turbulent combustion process in a practical jet engine afterburner is carried out; and the numerical velocity field, the temperature and concentration contour distribution, the efficiency of burning, and the recovery coefficient of total pressure are obtained. The results indicate that the proposed turbulent combustion model is characterized by high solvability.
Author (AIAA)
Jet Engines; Afterburning; Aircraft Engines; Turbulent Combustion; K-Epsilon Turbulence Model; Fuel Injection

19980071395
The effect of transient heat transfer on compressor surge margin
Wang, Zhangxue, Northwestern Polytechnical Univ., China; Tang, Diyi, Northwestern Polytechnical Univ., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 65-68; In Chinese; Copyright; Avail: Aeroplus Dispatch

The effect of transient heat transfer on the stability of axial flow compressors is analyzed. Based on the analysis, a mathematical model is established to study the effect of transient heat transfer on compressor surge margin. According to the established model, a turbofan engine with a compression ratio of 26 is investigated. The results show the validation of the model.
Author (AIAA)
Turbofan Engines; Turbocompressors; Heat Transfer; Transient Response; Compression Ratio; Flow Stability

19980071396
An investigation of the temperature profile before and after the turbine in a type of engine
Zhang, Hongbin, Chinese Air Force, 1st Inst., China; Li, Guangzhong, Chinese Air Force, 1st Inst., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 69-72; In Chinese; Copyright; Avail: Aeroplus Dispatch

The temperature profile quality at the engine combustor exit (before the turbine) is a important technical index which concerns the operational reliability and life of the engine's thermal component. Measurement of the temperature profile at the combustor exit (before the turbine) in an engine is therefore very important. A method for measuring the temperature profile before and after the turbine in a type of turbojet is presented, and the measured results are analyzed. It is concluded that the after-temperature-profile turbine differs from the one before the turbine.
Author (AIAA)
Turbojet Engines; Inlet Temperature; Temperature Profiles; Combustion Chambers; Temperature Measurement

19980071426

The CFM56-7 engine - Innovations and technologies ***Le moteur CFM56-7 - Innovations et technologies***

Thouraud, Pierre, SNECMA, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Apr. 1997; ISSN 1247-5793, no. 2, pp. 44-49; In French; Copyright; Avail: Aeroplus Dispatch

On December 17, 1996, the CFM56-7 aircraft engine was jointly certified, respectively, by the French and U.S. agencies DGAC (Direction Generale de l'Aviation Civile) and the FAA. This significant milestone was reached less than 42 months after the July 1993 program start and came about as a result of the undertaking of new approaches for conducting an engine program: implementation of a new methodology for conducting the detailed definition of the product, including the active participation of the customer, Boeing, the airplane manufacturer; and organization by multidiscipline working teams for implementing the engineering tasks, each team being responsible for an engine component, and all the engineering disciplines concerned being concurrently covered. The CFM56-7 is scheduled to enter into commercial service on October 1997 with the Boeing 737 'next generation' aircraft. The basic specifications of the CFM56-7, dictated as early as the beginning of the definition phase, are outlined. The CFM56-7 keeps the main CFM engine characteristics in terms of architecture. With respect to the other CFM engines, the basic difference consists in the presence of a wide chord fan blade. The CFM56-7 is the first engine developed by using a full digital mock-up system.

AIAA

Aircraft Engines; Boeing Aircraft; European Airbus

19980072298

Redefined propulsion tests target HSCT scale-up issues

Kandebo, Stanley W., USA; Aviation Week & Space Technology; Oct. 13, 1997; ISSN 0005-2175; Volume 147, no. 15, pp. 70-73; In English; Copyright; Avail: Aeroplus Dispatch

Managers of the High Speed Research program have redefined and restructured a number of upcoming propulsion tests aimed at reducing the risks associated with developing an engine for a Mach 2.4 High-Speed Civil Transport (HSCT). The process is discussed and progress being made on HSCT engine materials is addressed.

AIAA

Combustion Chambers

19980072592

Changes in engine maintenance management

Cribbes, T. D., Canada; Aerospace Engineering; Dec. 1997; ISSN 0736-2536; Volume 17,, no. 12, pp. 7-9; In English; Copyright; Avail: Aeroplus Dispatch

Airlines increasingly are realizing that engine maintenance may not be a core activity. They cannot afford to underestimate their own real costs or fail to account for any element (quality, reliability, and cycle time) that goes beyond price to contribute to total cost. Over the years, airlines and original equipment manufacturers (OEMs) have used inventory as the main driver of maintenance operation times. With the large inventories available, there has been little motivation to keep maintenance time to the lowest level possible. In order to address the variation in cycle times, airlines often hold spare engines, which form another level of inventory. Poor inventory management prevents inventory reductions along with reducing turnaround time. The solution, discussed in this article, lies in attacking both inventory and operation time. An accurate forecasting system forms the foundation of any improvement in rework cycle time. The rework process starts when line maintenance signals a need for service. On that signal, the engine repair facility takes over. A detailed history of the key parts must be compiled from the engine's repair history. Engine-on-wing history will identify potential rework needs. Borescope inspection programs go beyond standard procedures to keep track of the key parts in order to foster requisition requirements for each engine before it arrives at the facility. The development of these processes in partnership with the OEM will take maintenance organization close to just-in-time material management while reducing industry on-shelf inventory. Coupled with corresponding rework turnaround-time reductions, fewer spare engines will be needed.

AIAA

Aircraft Engines; Engine Parts; Aircraft Maintenance; Engine Design

19980072769

A multidisciplinary design optimization approach for high temperature aircraft engine components

Tappeta, R., Notre Dame, Univ., USA; Nagendra, S., General Electric Co., USA; Renaud, J. E., Notre Dame, Univ., USA; 1998, pp. 1055-1065; In English

Contract(s)/Grant(s): NSF DMI-94-57179; NAG1-1561

Report No.(s): AIAA Paper 98-1819; Copyright; Avail: AIAA Dispatch

The present work focuses on the introduction of a multidisciplinary design optimization problem dealing with high-pressure engine components (e.g. turbine components, compressors etc.). The design problem addressed herein couples multiple analyses codes using NASTRAN, PATRAN, and Response Surface Approximations for modeling a stepped beam representation of an aircraft engine blade with internal cavities. The multidisciplinary design problem is posed as a simple multilevel design analysis problem comprised of individual analysis models and an embedded fluid mechanics (EBFM) model that essentially captures the aerodynamic heating phenomena and heat transfer characteristics of a blade. This work proposes a potential industry benchmark to study multidisciplinary algorithms on scaleable real-world problems.

Author (AIAA)

Aircraft Engines; Engine Parts; Engine Design; Optimization; Finite Element Method

19980072795

Vibration of a mistuned blade-disk assembly using structurally damped beams

Turcotte, Jeffrey S., USAF, Inst. of Technology, USA; Hollkamp, Joseph J., USAF, Research Lab., USA; Gordon, Robert W., USAF, Research Lab., USA; 1998, pp. 1321-1328; In English

Report No.(s): AIAA Paper 98-1850; Copyright; Avail: AIAA Dispatch

A model of a mistuned bladed disk is created by connecting structurally damped, Euler-Bernoulli beams together at one end using springs. The model is useful in the prediction of the response of a turbine engine bladed disk in which only some of the blades have added damping. (This situation arises in the experimental analysis of damping treatments.) The natural frequencies and eigenfunction sets are obtained by assuming harmonic motion and imposing the boundary conditions. The eigensolution was verified using a small NASTRAN model. The forced response due to phased, harmonic tip loads is obtained by modalizing the equations using a technique recently developed by Turcotte. The physical response is obtained as a function of forcing frequency by truncation and summation of the modal responses. The results are in general agreement with existing discrete models.

Author (AIAA)

Disks (Shapes); Mistuning (Turbomachinery); Vibration Damping; Turbine Engines; Turbine Blades; Structural Vibration

19980073013

Optimization of turbomachinery airfoil shape for improved performance

Jha, Ratneshwar, Arizona State Univ., Tempe, USA; Chattopadhyay, Aditi, Arizona State Univ., Tempe; Rajadas, John N., Arizona State Univ., Mesa; Apr. 1998; In English

Report No.(s): AIAA Paper 98-1917; Copyright; Avail: AIAA Dispatch

A new multidisciplinary optimization procedure has been developed for the design of a turbine blade profile. Aerodynamic and heat transfer design objectives are integrated along with various mechanical constraints on the blade geometry. The airfoil shape is represented by Bezier-Bernstein polynomials, which results in a relatively small number of design variables for the optimization. Thin shear layer approximation of the Navier-Stokes equation is used for the viscous flow calculations. Grid generation is accomplished by solving Poisson equations. The maximum and average blade temperatures are obtained through a finite element analysis. Total pressure and exit kinetic energy losses are minimized, with constraints on blade temperatures and geometry. The constrained multiobjective optimization problem is solved using the Kreisselmeier-Steinhauser (K-S) function approach. The results for the numerical example show significant improvements after optimization.

Author (AIAA)

Airfoil Profiles; Aircraft Engines; Multidisciplinary Design Optimization; Turbine Blades; Aerodynamic Heat Transfer

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19980049034

Lateral jet control of a supersonic missile - Computational and experimental comparisons

Srivastava, B., Raytheon Co., USA; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 140-146; In English

Report No.(s): AIAA Paper 97-0639; Copyright; Avail: Aeroplus Dispatch

Several three-dimensional, viscous, turbulent Navier-Stokes computations have been performed for a missile equipped with and without divert jet thruster for three different wing planforms (having a fixed tail configuration) at a nominal flow Mach number of 3.94, angles of attack ranging from 2 to 25 deg, and jet thrust ratios of one and four. Results are presented to show that the normal force and pitching moment coefficients for all computed cases are predicted within 5 percent of the wind-tunnel data. Synthesis of all of the results show low amplification factor for all windward jet thruster cases. For this case the upstream favorable pressure zone created by the windward jet is insufficient to compensate for the massive unfavorable pressure loss on the windward wings/tails due to the jet blockage and jet wraparound effects.

Author (AIAA)

Lateral Control; Jet Control; Missile Control; Three Dimensional Flow; Viscous Flow; Navier-Stokes Equation

19980049062

Architecture of a novel mission controller for advanced unmanned air vehicles

Yavnai, Arie, Rafael Armament Development Authority, Israel; 1998, pp. 103-114; In English; Copyright; Avail: Aeroplus Dispatch

The architecture of an innovative embedded autonomous mission controller (AMC) to be used onboard future high autonomy unmanned air vehicles (UAVs), is presented. The AMC is designed to be a key element in the avionics suit of future UAVs. It is designed to provide the UAV with extended capability to operate autonomously in each of the following operational modes: (1) single vehicle mode and (2) cooperative multi-ship mode. This capability is based on the following onboard, real-time, self-contained functionalities provided by the AMC: (1) goal-directed event-driven reactive mission and system management throughout the entire mission cycle; (2) in-flight replanning and plan updating; (3) reasoning about events and situation; (4) context-sensitive event-driven exception handling; (5) coordinating the operation of an individual UAV with other UAVs while operating in cooperative multi-ship operation mode; and (6) optimal resource management.

Author (AIAA)

Pilotless Aircraft; Flight Control; Controllers; Architecture (Computers); Computer Programming

19980049158

Probing of helicopter maneuverability

Gao, Zheng, Nanjing Univ. of Aeronautics and Astronautics, China; Sun, Chuanwei, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 666-673; In Chinese; Copyright; Avail: Aeroplus Dispatch

The qualitative explanation and the parameters for quantitative evaluation of helicopter maneuverability are presented. The effect of maneuverability on the mission efficiency of helicopters, the relationship between maneuverability and agility, and the design parameters which determine the maneuverability are discussed. Requirements for helicopter response in the frequency domain and flight-test regulations in the U.S. Army ADS-33 are reviewed. Using the example of an integral control system, this paper analyzes the importance of auto-control theory and electronic technology for improving helicopter maneuverability.

Author (AIAA)

Helicopter Design; Aircraft Maneuvers; Automatic Control; Flight Control; Flight Tests

19980049159

Analysis of flight performance for a coaxial helicopter

Liang, Haitao, Nanjing Univ. of Aeronautics and Astronautics, China; Guo, Caigen, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Ping, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 638-643; In Chinese; Copyright; Avail: Aeroplus Dispatch

The aerodynamic characteristics of coaxial rotors in hover and forward flights are analyzed from the point of view of preliminary design. A computation method is found, and a performance calculation program is available for the preliminary design. For

the hovering state, momentum theory is applied; and after reasonable simplification and analysis, equations which can be used to calculate the performance of a coaxial helicopter with different disk displacements are obtained. Comparison of the calculation results presented in the paper with test results on a rotor test stand indicates that the proposed method is quite effective for the preliminary design of a coaxial helicopter.
Author (AIAA)
Helicopter Design; Flight Characteristics; Coaxial Flow; Aerodynamic Characteristics

19980049586
VIATO - Visual Interactive Aircraft Trajectory Optimization
Virtanen, Kai, Helsinki Univ. of Technology, Finland; Ehtamo, Harri, Helsinki Univ. of Technology, Finland; Raivio, Tuomas, Helsinki Univ. of Technology, Finland; Hamalainen, Raimo P., Helsinki Univ. of Technology, Finland; 1997, pp. 2280-2285; In English; Copyright; Avail: Aeroplus Dispatch
An approach towards automated solution of aircraft trajectory optimization problems is introduced and applied to an interactive MS-Windows software called ’Visual Interactive Aircraft Trajectory Optimization’ (VIATO). The software solves, e.g., minimum time trajectories to a fixed or to a moving target. It consists of an automated optimization routine and a graphical user interface. The software is easy to use and thus its user does not need to know optimal control theory and mathematical modeling. Most mathematical models of flight vehicles are structurally similar and differ only in their parameters. In VIATO software the equation of motion and the state and the control constraints are fixed in advance, and different aircraft types are represented as a set of parameters. Specifying also the objective functions of the optimal control problems, the explicit formulation of optimal control problems is totally avoided. Reliable convergence of the solution methods is achieved by replacing the original infinite-dimensional problem with a finite-dimensional approximation. The approximation is solved using nonlinear programming.
Author (AIAA)
Aircraft Control; Flight Paths; Trajectory Optimization; Interactive Control; Software Development Tools; Visual Control

19980049644
Active control technology of helicopter aeromechanical stability
Chen, Aihua, Nanjing Univ. of Aeronautics and Astronautics, China; Gu, Zhongquan, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 621-626; In Chinese; Copyright; Avail: Aeroplus Dispatch
The active control of helicopter air and ground resonance is a newly developing technology with great potential. At present there are two kinds of control approaches: by blade pitch and by trailing edge flap. The theoretical research work in this field is summarized, including the mechanism of control, the mathematical model, and the control law and its design method. Problems and trends in active control technology for controlling such dynamical stability problems are pointed out, and our points of view are expressed.
Author (AIAA)
Helicopter Control; Active Control; Dynamic Stability; Pitching Moments; Trailing Edge Flaps

19980049647
Measurement and calculation of rotor loads in forward flight
Bao, Jinsong, Nanjing Univ. of Aeronautics and Astronautics, China; Sun, Jun, Nanjing Univ. of Aeronautics and Astronautics, China; Zhang, Xiaogu, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 644-647; In Chinese; Copyright; Avail: Aeroplus Dispatch
An experiment to measure rotor loads in forward flight was designed, and the test was conducted on a rotor model test stand in a 4.25 m x 5.1 m wind tunnel. The rotor model for the experiment is a 2-m-diameter, four-blade hinged rotor. The forces and moments of the rotor are measured with collective pitch input and longitudinal cyclic pitch input, in two advance ratios. A method is developed to calculate the rotor loads in forward flight, with dynamic inflow taken into account. The correlation between analytical predictions and test data is good. The deviation between the calculations with dynamic inflow and without dynamic inflow is significant with the collective pitch input, whereas the deviation is small with the longitudinal cyclic pitch input.
Author (AIAA)
Aerodynamic Loads; Rotary Wings; Wind Tunnel Tests; Aircraft Stability; Rotor Blades

19980049649
Measurement of the unsteady wake of a rotor in hover
Chen, Renliang, Nanjing Univ. of Aeronautics and Astronautics, China; Ming, Xiao, Nanjing Univ. of Aeronautics and Astronau-

tics, China; Mei, Weisheng, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 654-659; In Chinese; Copyright; Avail: Aeroplus Dispatch

The paper presents wake unstable characteristics and two-component velocities measured with a hot-wire anemometer. The blade tip vortex trajectory, the time-averaged velocity distribution along wake radii, and instantaneous velocities at a series of distances below the rotor disk were measured. The wake geometry tip vortex expansion and dissipative characteristics are found. The effects of blade pitch and blade numbers on vortex structure, vortex path, and wake geometry are studied. The results indicate that the maximum mean induced velocity of the wake exceeded twofold the magnitude of momentum theory and that the maximum instantaneous value of the vertical velocity component in the vicinity of vortex trails could be as large as ten times the momentum value of induced velocity. The effects of varying the test parameters are reflected in significant changes of flow within the rotor tip vortex trails and the small variations of velocity components of the inner wake region. The near wake geometry agrees well with that of a prescribed wake model.

Author (AIAA)

Rotary Wings; Unsteady Aerodynamics; Helicopter Wakes; Rotor Speed; Blade-Vortex Interaction

19980051038

Development on agility, post-stall maneuver, flying qualities and thrust vector control

Liu, Chang, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 72-80; In Chinese; Copyright; Avail: Aeroplus Dispatch

The development of agility, post-stall maneuver, flying qualities, and thrust vector control and their mutual relationships are summarized and discussed. Agility application reseach; the relationships between agility, post-stall maneuver flying qualities, and thrust vector control; and the establishment of a rational post-stall maneuver model and the appropriate control method are considered. How agility and post-stall maneuver can be incorporated in the advanced fighter design process has been examined.

Author (AIAA)

Thrust Vector Control; Aircraft Maneuvers; Aircraft Design

19980051560

Design method of LQG/LTR for a flight-path control system

Zhao, Chao, Northwestern Polytechnical Univ., China; She, Xueren, Northwestern Polytechnical Univ., China; Zhou, Fengqi, Northwestern Polytechnical Univ., China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 22-28; In Chinese; Copyright; Avail: Aeroplus Dispatch

LQG/LTR is a frequency-domain multivariable control methodology which is widely used because of its good robustness and decoupling properties. However, it is effective only for a minimal-phase plant. This paper presents the intuitive principles of LQG/LTR, discusses the nonminimal-phase problem and some important issues in multivariable feedback design, and applies this method to the design of a longitudinal flight-path control system for an aircraft. The model uncertainty of the aircraft and the effect of random gust are considered. Final simulation results are ideal.

Author (AIAA)

Linear Quadratic Gaussian Control; Flight Paths; Flight Control; Control Systems Design; Loop Transfer Recovery

19980051808

Energy state approach to the integrated flight performance management of commercial aircraft

Wu, Shufan, Nanjing Univ. of Aeronautics and Astronautics, China; Reichert, Guenther, Braunschweig, Technical Univ., Germany; Nanjing University of Aeronautics & Astronautics, Transactions; Dec. 1997; ISSN 1005-1120; Volume 14, no. 2, pp. 101-108; In English; Copyright; Avail: Aeroplus Dispatch

Integrated aircraft flight performance management techniques are discussed, based on the point-mass energy state approximation principle. The flight performance optimization algorithms, developed with the energy state approximation approach, are first introduced. The functionally integrated flight path/speed control system, called the total energy control system (TECS), is then discussed, and the guidance technique and the algorithms which relate the performance optimization results directly with the TECS are analyzed and developed. Digital simulation results for a specific transport aircraft model demonstrate the satisfactory performance of the resulting flight performance management system.

AIAA

Commercial Aircraft; Aircraft Performance; Energy Methods; State Estimation; Flight Management Systems; Flight Control

19980055509

Oscillatory control of separation and high Reynolds numbers

Seifert, A., NASA Langley Research Center, USA; Pack, L. G., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0214; Copyright; Avail: Aeroplus Dispatch

A recent experiment conducted in a pressurized cryogenic wind tunnel demonstrates that unsteady flow control using oscillatory blowing (with essentially zero mass flux) can effectively delay flow separation and reattach separated flow on an airfoil at chord Reynolds numbers as high as 31 x 10 exp 6. Oscillatory blowing at reduced frequencies in the range 0.5 to 1 is effective over the entire Re range, in accordance with previous low Re tests. Similar gains in airfoil performance require steady blowing with a momentum coefficient that is two orders of magnitude greater. Stall is delayed and poststall characteristics are improved when oscillatory blowing is applied from the leading edge region of the airfoil, while flap effectiveness is increased when control is applied at the flap shoulder. A detailed experimental investigation (accompanied by theory) was undertaken in order to estimate the oscillatory blowing momentum coefficient used in the cryogenic wind tunnel experiment. It is concluded that the application of active separation control to a commercial jetliner at take-off is within reach.
Author (AIAA)

High Reynolds Number; Cryogenic Wind Tunnels; Unsteady Flow; Oscillating Flow; Separated Flow; Reattached Flow

19980055612

The effect of compressibility on suppression of dynamic stall using a slotted airfoil

Carr, L. W., NASA Ames Research Center, USA; Chandrasekhara, M. S., NASA, USA; Wilder, M. C., MCAT, Inc., USA; Noonan, K. W., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0332; Copyright; Avail: Aeroplus Dispatch

A multielement airfoil designed for helicopter application has been tested for compressible dynamic stall behavior, and has proven to be a very robust dynamic-stall-free concept. This slotted airfoil has operated into poststall areas without the dynamic stall vortex that is normally present whenever airfoils are tested beyond their static stall boundary. Point diffraction interferogram images of the dynamic flow over the airfoil are presented, showing details of the flow development during the oscillation cycle, and instantaneous pressure distributions on the airfoil and slat during dynamic airfoil motion are included.
Author (AIAA)

Compressibility; Aerodynamic Stalling; Slots; Airfoil Profiles; Rotary Wings

19980055711

Low-gravity flight director for free-floating experiments - DC-9 testing

Allan, A. P., APA Consulting, USA; Logsdon, Kirk A., NASA Lewis Research Center, USA; McKnight, Robert C., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0453; Copyright; Avail: Aeroplus Dispatch

Free-float experiment packages in aircraft low-gravity trajectories have previously had short and variable free-float duration. A flight director has been shown to improve both. Aircraft parameter identification, pilot modeling, and modern control synthesis were used to design the flight director. A sophisticated experimental setup was used to verify the approach. The technology developed is available for implementation in current and future aircraft engaged in low-gravity research.
Author (AIAA)

Aircraft Control; Pilot Performance; Flight Tests; Gravitational Effects; NASA Programs; Longitudinal Stability

19980055736

Probabilistic assessment of handling qualities characteristics in preliminary aircraft design

Mavris, Dimitri N., Georgia Inst. of Technology, Atlanta, USA; DeLaurentis, Daniel A., Georgia Inst. of Technology, Atlanta; Soban, Danielle S., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0492; Copyright; Avail: Aeroplus Dispatch

A method is introduced and demonstrated which uses parametric stability derivative data (in the form of regression equations) and probabilistic analysis techniques to evaluate the impact of uncertainty on the handling qualities characteristic of a family of aircraft alternatives. While the method is based on the use of elementary design parameters familiar to the configuration designer, it enables the computation of responses more familiar to the stability and control engineer. This connection is intended to bring about a more complete accounting of stability and handling quality characteristics in aircraft design, based on engineering analysis instead of historical data. Another key advantage of the method is that it allows for the quantification of analysis imprecision and information quantity/quality tradeoffs through fidelity uncertainty models. The metrics for these quantifications are the cumulative distribution function and the probability sensitivity derivatives. The method is exemplified through the investigation of the

longitudinal handling qualities trends for a defined High Speed Civil Transport design space, in the presence of fidelity uncertainty in the stability derivatives.
Author (AIAA)
Controllability; Aircraft Design; Probability Theory; Aircraft Control

19980055737

Development of supersonic demonstration maneuvers with the NASA SR-71 aircraft and simulator

Klyde, David H., Systems Technology, Inc., USA; Mitchell, David G., Hoh Aeronautics, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0493; Copyright; Avail: Aeroplus Dispatch

This paper describes the development of a set of supersonic handling qualities maneuvers for the Air Force Demonstration Maneuvers Program. Initial development by Systems Technology, Inc. (STI) began as part of a program with NASA Dryden Flight Research Center (DFRC) to develop high-speed supersonic and hypersonic handling qualities criteria through flight tests conducted with NASA SR-71 aircraft. In this effort a set of evaluation maneuvers was developed using the DFRC SR-71 piloted simulator to expose potential handling qualities deficiencies in large, high-speed aircraft. The performance requirements for these maneuvers included 'urgency factors' that were designed to increase the pilot's gain without using unrealistic time-based constraints. NASA SR-71 aircraft were used to perform a total of 16 evaluations over six flights involving two pilots. The results from these flights were later used as part of the Demonstration Maneuvers Program to develop four of six proposed supersonic handling qualities demonstration maneuvers. The remaining two were based on analogous subsonic maneuvers. Based on pilot commentary and quantitative results, revisions were made to the maneuver definitions, performance requirements, and urgency factors.
Author (AIAA)
Supersonic Aircraft; SR-71 Aircraft; Flight Simulators; Aircraft Maneuvers; Aircraft Control

19980055738

Predicting handling qualities levels for vehicles with nonlinear dynamics

Hess, R. A., California, Univ., Davis, USA; Stout, P. W., California, Univ., Davis; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-1744
Report No.(s): AIAA Paper 98-0494; Copyright; Avail: Aeroplus Dispatch

A technique for the prediction of handling qualities levels for vehicles with linear dynamics, recently described in the literature, is here extended to vehicles with nonlinear dynamics. This technique relies upon a structural model of the human pilot and a set of rules for selecting this model's parameters. The technique is an extension of a methodology for predicting a vehicle's susceptibility to pilot-induced oscillations when significant nonlinearities exist in the vehicle description. Taken as a whole, the research to be described and that which has gone previously provide a unifying theory for the handling qualities of vehicles with linear or nonlinear dynamics. The technique is first applied to the HAVE LIMITS series of flight tests conducted on the Air Force/CALSPAN variable stability NT-33A aircraft. It is then applied to a hypothetical aircraft to evaluate the effectiveness of a software rate limiter.
Author (AIAA)
Aircraft Control; Feedback Control; Nonlinear Systems; Flight Tests; Aircraft Pilots; Pilot Induced Oscillation

19980055739

Flight control in non-linear maneuvers

Nagati, M. G., Wichita State Univ., USA; Lee, Dong-Chan, Wichita State Univ., USA; Jaramillo, Paul T., A-P-T Research, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0496; Copyright; Avail: Aeroplus Dispatch

This paper discusses a continuing research effort to further develop and validate a new concept for control augmentation. This concept is intended to recover general aviation (GA) aircraft from stalls or spins, or high performance aircraft performing violent maneuvers e.g. oscillatory spins, falling leaf, etc. The spin maneuver of a GA aircraft has been used for the background work as the original objective was the development of a strategy for spin recovery in this type of aircraft. In addition, high quality, spin-flight-test data from NASA-Langley was made available. Spins were thus used as an example to illustrate a more general flight condition in which highly nonlinear effects predominate. In a related study, some of the concepts discussed here were successfully applied to arrest the falling leaf motion in a high fidelity, large-angle simulation of a fighter aircraft. The broader scheme is applicable to more general flight maneuvers involving large angles-of-attack and sideslip and/or large angular rates.
Author (AIAA)
Flight Control; Aircraft Maneuvers; General Aviation Aircraft; Flight Tests

19980055740

Application of fuzzy logic to wing rock motion control

Nho, Kyungmoon, Wichita State Univ., USA; Agarwal, Ramesh K., Wichita State Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0497; Copyright; Avail: Aeroplus Dispatch

A simple proportional and derivative (PD) type fuzzy logic inference, involving self-tuning by altering scaling coefficients for fuzzy controller (FC) input variables, is here applied to control the nonlinear wing rock motion. The update of scaling coefficients is performed by introducing another fuzzy logic inference called fuzzy self-tuner (FST). It is shown that PD-type FC is well suited for controlling unstable dynamical behavior described by nonlinear equations of motion effectively. Two different wing rock models are employed to demonstrate the handling capability of FC over a wide range of initial conditions. For practical purposes, the deflection angle and the rate of aileron actuator are limited during numerical simulation of wing rock motion control.

Author (AIAA)

Wing Rock

19980055741

Wing rock of slender delta wings in light of recent investigations

Ericsson, Lars E., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0498; Copyright; Avail: Aeroplus Dispatch

An analysis of published experimental and theoretical results for slender wing rock has been performed to pinpoint the flow physics and provide the vehicle designer with the information needed to include slender wing rock considerations early in the design phase. A direct demonstration of the roll-rate-induced camber effect is furnished by the test results obtained at zero angle-of-attack for a rolling, 80-deg delta wing.

Author (AIAA)

Wing Rock; Delta Wings; Slender Wings; Flight Tests

19980055743

Decoupling control law design with applications to flight

Snell, Antony, California, Univ., Davis, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0500; Copyright; Avail: Aeroplus Dispatch

Dynamic inversion is presented as a general tool for designing decoupling control laws for multivariable systems. The main focus of the paper is on applications to linear systems, although some results may extend to nonlinear systems. The issue of zero dynamics and nonminimum phase is discussed in the linear context. Three examples are presented relating to decoupling of lateral-directional dynamics for highly maneuverable aircraft.

Author (AIAA)

Control Systems Design; Multivariable Control; Linear Systems; Aircraft Maneuvers; SISO (Control Systems)

19980055744

Design of automatic landing systems using mixed H2/H-infinity control

Shue, Shyh-Pyng, Wichita State Univ., USA; Agarwal, Ramesh K., Wichita State Univ., USA; Kuo, Yao-Huang, Wichita State Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0501; Copyright; Avail: Aeroplus Dispatch

A mixed H2/H-infinity control technique is employed to develop controllers for autolanding systems for a commercial airplane. A linear model of the aircraft in longitudinal motion is established using the appropriate aerodynamic coefficients. With the control actuator, tracking errors, and altitude motion, the aircraft is shown to be governed by an augmentation system along with its filter model. Two kinds of optimal and robust control requirements are designed, which need to be satisfied simultaneously. One of requirements is with respect to an optimal trajectory selection for landing routes. The H2 method is used to minimize a cost function such that the optimal gain for trajectory optimization can be obtained. The other requirement is with respect to the disturbance attenuation. The H-infinity technique is employed to obtain the necessary formulation for the robust control gain to minimize the affection of the disturbance to the performance output. An algorithm is developed based on the convex theory for the mixed H2/H-infinity control and filter gains, which provides a suboptimal solution. A 747-200 is employed to illustrate the potential of the proposed method. It is shown that the glide slope capture motion and flare maneuver of the aircraft are accomplished quite well, and the amplitudes of all maneuver are within FAA requirements.

Author (AIAA)

Automatic Landing Control; Control Systems Design; H-2 Control; H-Infinity Control; Commercial Aircraft

19980055745

Maximum likelihood identification of linear aircraft dynamics using a hybrid genetic algorithm

Bruce, Peter D., Cranfield Univ., UK; Kellett, Martin G., Cranfield Univ., UK; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0502; Copyright; Avail: Aeroplus Dispatch

This paper presents the use of a hybrid genetic algorithm for the maximum likelihood identification of linear aircraft dynamics. The technique is compared to other minimization methods and is found to perform significantly better than a simple genetic algorithm. It is also compared to the conventional modified Newton-Rhapson method and to the simplex method. It has advantages over the modified Newton-Rhapson method in that initial parameter estimates do not have to be stated; rather, a bound on the parameters is given. It also does not suffer from numerical problems sometimes evident with gradient-based optimization techniques. It is also simple to incorporate initial parameter estimates, if available.

Author (AIAA)

Maximum Likelihood Estimates; Genetic Algorithms; Linear Systems; Aerodynamics; Flight Tests; Flight Characteristics

19980055763

Effect of configuration pitching motion on twin tail buffet response

Sheta, Essam F., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG1-648

Report No.(s): AIAA Paper 98-0520; Copyright; Avail: Aeroplus Dispatch

The effect of dynamic pitch-up motion of a delta wing on twin-tail buffet response is investigated. The computational model consists of a delta wing-twin tail configuration. The computations are carried out on a dynamic multiblock grid structure. This multidisciplinary problem is solved using three sets of equations which consist of the unsteady Navier-Stokes equations, the aeroelastic equations, and the grid displacement equations. The configuration is pitched-up from zero up to 60 angle of attack, and the freestream Mach number and Reynolds number are 0.3 and 1.25 million, respectively. With the twin tail fixed as rigid surfaces and with no forced pitch-up motion, the problem is solved for the initial flow conditions. Next, the problem is solved for the twin-tail response for uncoupled bending and torsional vibrations due to the unsteady loads on the twin tail and due to the forced pitch-up motion. The dynamic pitch-up problem is also solved for the flow response with the twin tail kept rigid. The configuration is investigated for inboard position of the twin tail, which corresponds to a separation distance between the twin tail of 33 percent wing chord.

Author (AIAA)

Pitching Moments; Delta Wings; Buffeting; Computational Grids; Aeroelasticity; Navier-Stokes Equation

19980055816

HVASC - HyperVelocity AeroStructural Code

Legner, H. H., Physical Sciences, Inc., USA; Lo, E. Y., Physical Sciences, Inc., USA; Miller, M. G., Physical Sciences, Inc., USA; Reinecke, W. G., Texas, Univ., Austin; Jan. 1998; In English

Contract(s)/Grant(s): DAAA21-93-C-0101

Report No.(s): AIAA Paper 98-0582; Copyright; Avail: Aeroplus Dispatch

A new HyperVelocity AeroStructural Code (HVASC) has been developed. This code calculates 6-degree-of-freedom (DOF) rigid-body motion, 8-DOF structural flexure in pitch and yaw planes, and in-flight deployment of axially-extendable projectiles with multiple segments. HVASC has been validated against ballistic range data; it has also been used to analyze complex in-flight shape-changing projectiles due to deployment/extension, segmentation, flexure, and aerothermal nose/fin recession.

Author (AIAA)

Hypervelocity Projectiles; Aerodynamic Characteristics; Dynamic Structural Analysis; Computer Techniques

19980055817

Near optimal midcourse guidance law for flight vehicle

Kee, Poh E., Defence Science Organisation, Singapore; Dong, Li, Defence Science Organisation, Singapore; Siong, Chai J., Defence Science Organisation, Singapore; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0583; Copyright; Avail: Aeroplus Dispatch

The standard formulation of optimal guidance problem results in a complex nonlinear two-point boundary value problem which imposes a tremendous computational burden. In contrast to the open loop solution of the optimal guidance law, which is dependent on the given initial conditions, we have developed a closed loop near-optimal midcourse guidance law which minimizes flight time and/or fuel consumption. We have compared the performance of the near-optimal guidance law with those of the con-

ventional proportional navigation (PN) and optimal guidance law and found that the near-optimal guidance is superior to the PN guidance and is comparable to the optimal guidance law.
Author (AIAA)
Midcourse Guidance; Optimal Control; Feedback Control; Flight Optimization; Flight Time; Fuel Consumption; Trajectory Optimization; Recursive Functions

19980055885

A real-time atmospheric turbulence model for aircraft flight simulators

Ninham, Cameron P., Illinois, Univ., Urbana, USA; Raju, Renchi, Illinois, Univ., Urbana; Selig, Michael S., Illinois, Univ., Urbana; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0668; Copyright; Avail: Aeroplus Dispatch

This paper demonstrates a computationally efficient method of providing realistic atmospheric turbulence data that can easily be incorporated into a flight simulator. The turbulence data are derived from the SNLWIND-3D program, which is based on a Monte Carlo approach. Although the SNLWIND-3D code was originally developed for use with wind turbine design and analysis methods, the turbulence data that are generated by the code can readily be adapted and used to develop an atmospheric turbulence model for use within a flight simulator system, as described later in this paper. The new turbulence model will soon be a key element of the Navy Pioneer unmanned aerial vehicle training simulator. This simulator is now used for training Navy pilots at DOD UAV Training Center (DUTC), Ft. Huachuca, AZ.
Author (AIAA)

Flight Simulators; Atmospheric Models; Real Time Operation; Atmospheric Turbulence; Pilotless Aircraft; Turbulence Models

19980055886

Use of a global eddy dissipation rate climate to calculate B747 vertical acceleration exceedance rates

Tank, W. G., Boeing Co., USA; Soreide, D. C., Boeing Co., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0670; Copyright; Avail: Aeroplus Dispatch

Linear system response analysis applied to calculating the response of airplanes to a disturbed environment requires two descriptors of atmospheric disturbances, namely, the disturbance variance spectral density and the probability density of disturbance intensity. Uncontrolled airplane responses are due for the most part to disturbances in the size range of a few to a few thousand meters. In this case the required descriptors for response analysis can be expressed in terms of a single metric, the eddy dissipation rate, epsilon, of 3D isotropic turbulence theory. It is then argued that in the upper troposphere and the lower stratosphere, response calculations can be based on a global epsilon climate developed from epsilon-estimates based on variance spectral densities of essentially 2D, very large scale disturbances (spatial scales of order hundreds of km) as measured during the Global Atmospheric Sampling Program (GASP). The geometric mean epsilon and its geometric standard deviation for the North Atlantic air corridor are discussed, and examples of their application to calculating the exceedance rate of center-of-gravity vertical accelerations of B747 airplanes in cruise configuration are shown.
Author (AIAA)

Boeing 747 Aircraft; Vertical Flight; Energy Dissipation; Atmospheric Turbulence; Aircraft Control; Aviation Meteorology

19980055889

Dynamic delta wing pitch-up control via apex flaps

Schaeffler, Norman W., Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Telionis, Demerti P., Virginia Polytechnic Inst. and State Univ., Blacksburg; Jan. 1998; In English

Contract(s)/Grant(s): F49620-93-1-0455
Report No.(s): AIAA Paper 98-0673; Copyright; Avail: Aeroplus Dispatch

An experimental investigation is reported for the flow over a 75-deg sweep angle delta wing undergoing a ramp-like pitch-up motion from a 20-deg angle of attack to a 50-deg angle of attack at reduced frequencies of 0.0053, 0.0144, and 0.011 and Reynolds numbers of 532,000 and 1.0 x 10 exp 6. During the pitch-up motion, a 15-deg flap-angle apex flap was deployed. The time history of the surface pressure distribution on two cross flow planes was obtained for different deployment times of the apex flap. An analysis of the surface pressure distribution revealed that apex flap deployment had a promising effect on the surface pressure distribution if the flap was deployed before vortex breakdown had moved over the wing. This effect was maximal if the flap was deployed early in the pitch-up motion. Changes in the surface pressure coefficient as high as 15 percent were observed. The

deployment of the flap was shown to increase its effect on the flow field over the effect of having the flap continuously deployed during the motion.
Author (AIAA)
Delta Wings; Pitching Moments; Flaps (Control Surfaces)

19980055891

Control of dynamic stall using pulsed vortex generator jets

Magill, John C., Physical Sciences, Inc., USA; McManus, Keith R., Physical Sciences, Inc., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-97052
Report No.(s): AIAA Paper 98-0675; Copyright; Avail: Aeroplus Dispatch

This paper addresses the problem of controlling unsteady separation over aerodynamic surfaces using a closed-loop controller with surface-embedded pneumatic actuators. The specific goal of this work was to demonstrate the control of transient stall on a pitching wing using pulsed vortex generator jets (PVGJs). This demonstration entailed the design, construction, and aerodynamic characterization of a wing model fitted with PVGJs. The open-loop experimental results served to guide the design of a closed-loop controller which would cause the pressure at a point on the wing to track a prescribed function. Closed-loop experiments revealed that the algorithm, although simple, was successful at providing this tracking. The successful application of the system for controlling separated flow over wings and other flight control surfaces will lead to improved aircraft safety and comfort, in commercial aircraft applications, and enhanced maneuverability and stability of military aircraft.
Author (AIAA)
Aerodynamic Stalling; Vortex Generators; Unsteady Aerodynamics; Unsteady Flow; Separated Flow; Feedback Control; Controllers; Flight Control; Control Surfaces; Pneumatic Equipment; Actuators

19980055892

Dynamic stall control by oscillatory forcing

Greenblatt, D., Tel Aviv Univ., Israel; Wygnanski, I., Tel Aviv Univ., Israel; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0676; Copyright; Avail: Aeroplus Dispatch

A parametric study was undertaken to investigate the effect of oscillatory forcing (with zero net mass-flux) on an airfoil undergoing pitch oscillations at rotorcraft reduced frequencies. The primary objective of the study was to maximize the airfoil performance while simultaneously limiting moment excursions to typical pre-stalled conditions. The incidence angle excursions were limited to +/- 5 deg, and a wide range of reduced forcing frequencies and amplitudes were considered for Re not greater than 0.3 x 10 exp 6 with various flap deflections and forcing locations. Significant increases in maximum lift and reductions in form drag were attained while simultaneously containing the moment excursions. Oscillatory forcing was found to be far superior to steady blowing, and flap-shoulder forcing was found to be superior to leading-edge forcing.
Author (AIAA)
Aerodynamic Stalling; Parameter Identification; Dynamic Control; Airfoils; Aircraft Performance; Optimization; Forced Vibration

19980055897

Experimental and numerical investigation of aerodynamic control of hypervelocity missiles

Agrell, J., Aeronautical Research Inst. of Sweden, Bromma, Sweden; Persson, M., Aeronautical Research Inst. of Sweden, Bromma; Ehn, G., Aeronautical Research Inst. of Sweden, Bromma; Landen, T., Aeronautical Research Inst. of Sweden, Bromma; Pettersson, K., Bofors Missiles, Sweden; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0681; Copyright; Avail: Aeroplus Dispatch

An experimental investigation of aerodynamic after-body control devices for a flare-tail stabilized missile at Mach number 7.15 is presented. Local aerodynamic forces and moments are measured on the aft part of the conical afterbody. Two concepts for aerodynamic control, spoilers and skirts, are studied. Spoilers create strong bow-shocks which give rise to high surface pressures and thereby significant normal forces. Large contributions to the tangential forces may, however, reduce the applicability at unpowered flight. The efficiency is reduced when spoilers are located on the leeward side. Body extensions or skirts utilize the pressure difference at the base of the body. Resulting normal forces are not especially strong, and the contribution to tangential forces is negligible. Numerical simulations of the hypersonic flow around the missile body without spoilers or skirts are also presented. Inviscid Euler solutions are in good agreement with experimental values. The influence from the side mounted support strut is limited when the strut is located on the leeward side.
Author (AIAA)
Hypervelocity Projectiles; Missile Control; Flight Control; Control Surfaces

19980055963

A formal approach to aerodynamic modeling for store separation

Chapman, Gary T., California, Univ., Berkeley, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0755; Copyright; Avail: Aeroplus Dispatch

The prediction of store separation from an aircraft is normally done using a combination of wind tunnel test data. These tests include measurements of the store forces and moments in the presence of the aircraft as well as independent measurements of the store aerodynamics by itself combined with measurements of the local flowfield around the aircraft through which the store must traverse. These methods are rather ad hoc. A formal approach to aerodynamic mathematical modeling of store separation from a parent aircraft is put forward. This approach is then expanded to show how it incorporates both approaches in present use.

Author (AIAA)

External Store Separation; Aerodynamic Characteristics; Wind Tunnel Tests; Flight Conditions; Flow Measurement

19980055965

Upwash flowfields at the tails of aircraft with outboard horizontal stabilizers

Kentfield, J. A. C., Calgary, Univ., Canada; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0757; Copyright; Avail: Aeroplus Dispatch

A brief description is given of the outboard horizontal stabilizer concept and related background material. Wind-tunnel tests were carried out to establish the flowfield directions in the vicinity of the outboard stabilizing surfaces. The results obtained showed that experimentally based corrections could be applied to a well known analytical expression to model, with reasonable accuracy, the flowfields prevailing at the tail regions of aircraft with outboard horizontal stabilizers. These data were subsequently applied to comparative performance analyses of outboard horizontal stabilizer and corresponding conventional aircraft over a range of pitch static-stability margins. It was found that for a representative, mid-range, value of the static stability margin an aircraft with outboard horizontal stabilizers has, at cruise conditions, a drag 20 percent, or more, less than that of a corresponding conventional aircraft with a planform area that is 10 percent, or more, smaller.

Author (AIAA)

Stabilizers (Fluid Dynamics); Upwash; Horizontal Tail Surfaces; Wind Tunnel Tests; Static Stability; Pitching Moments

19980055967

Aerodynamic investigations of the Freewing Tilt-Body UAV

Galls, Samuel F., Texas A & M Univ., College Station, USA; Furey, Deborah A., Texas A & M Univ., College Station; Rediniotis, Othon K., Texas A & M Univ., College Station; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0759; Copyright; Avail: Aeroplus Dispatch

The Freewing UAV by Freewing Aerial Robotics Corporation has demonstrated stability, gust alleviation, and near VTOL characteristics. However, limitations in existing analytic models constrain the development of model-based autopilots and design refinements. Presently, there is a need to further evaluate the vehicle's aerodynamic properties and control characteristics to enable the development of a reliable analytical model to be used in flight control. A 20 percent scaled model of the Freewing Tilt-Body vehicle was developed and tested to evaluate its aerodynamic properties and the effects of self-induced flows on the performance of the aircraft. Wind tunnel tests for validation and evaluation of various flight conditions and configurations were carried out. Particular attention has been paid to evaluating high angle of attack flight. The wind tunnel model is fully powered with moveable control surfaces and is instrumented with transducers for real time measurements of Freewing and propeller motion. An external three component balance is used for force and moment measurements as well as multi-hole probes for flow surveys. The tests were conducted using AeroView, a multi-media interactive flow-diagnostics environment.

Author (AIAA)

Aerodynamic Characteristics; Vertical Takeoff Aircraft; Automatic Pilots; Aircraft Design; Flight Control; Wind Tunnel Tests

19980055971

Modeling of unsteady flow about a fire fighting aircraft dropping the water bomb

Blaszczyk, Pawel, Warsaw Univ. of Technology, Poland; Goetzendorf-Grabowski, Tomasz, Warsaw Univ. of Technology, Poland; Goraj, Zdobyslaw, Inst. of Aviation, Poland; Sznajder, Janusz, Inst. of Aviation, Poland; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0763; Copyright; Avail: Aeroplus Dispatch

Unsteady incompressible potential flow over the whole aircraft dropping a water bomb is sequentially solved using low order panel methods. Constant strength source and doublet panels distributed over aircraft surface, constant strength doublet panels over flat wake and constant strength source together with linear strength doublet panels distributed over the vertical water column, being able to properly imitate the downward water outflow of growing velocity, are used to solve the Dirichlet's boundary condi-

tion. to be able to evaluate the influence of history of motion on pressure distribution, this unsteady approach was preceded by classical, steady flow analysis, both for aircraft without a water column and aircraft with a water column of assumed, finite length. The main focus was to analyze the effect of water release onto the values of lift, pitching moment and downwash. Comparison of the steady flow parameters with the selected parameters, taken from experimental investigations, validated the analysis. Assuming that the aircraft flight path is horizontal and is not influenced by the change of aircraft mass, it is found that unsteady flow, induced by water outflow, has negligible influence on aircraft aerodynamic characteristics. Numerical solution of the dynamic equations of aircraft motion under the assumption that aerodynamics is so-called quasi-steady, shows that aircraft response on water bomb dropping can be very abrupt, depending on design parameters and/or elevator and throttle control.
Author (AIAA)
Aircraft Configurations; Unsteady Flow; Fire Fighting; Panel Method (Fluid Dynamics); Flow Characteristics; Water Flow

19980056185

A mission-adaptable route planner for intelligent guidance/navigation systems

Szczerba, Robert J., Lockheed Martin Federal Systems, USA; Galkowski, Peggy, Lockheed Martin Federal Systems, USA; Glickstein, Ira S., Lockheed Martin Federal Systems, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1012; Copyright; Avail: Aeroplus Dispatch

Route planning for aircraft is an extremely complex problem. Standard route planning algorithms usually generate a minimum cost route (based on a predetermined cost function, relating factors such as terrain features, threat locations, mission requirements, etc.). Unfortunately, such a path may not represent an acceptable ’flyable’ route for various mission scenarios. In this paper, we present a novel route planning approach to generate mission-adaptable routes in both an accurate an efficient manner. The computed routes are able to take into account mission constraints including, but certainly not limited to, minimum leg length, maximum turning angle, overall route length, and fixed approach vectors. Furthermore, the routes can be computed in real-time and recomputed as new battlefield information becomes available.
Author (AIAA)
Aircraft Guidance; Trajectory Planning; Pilot Support Systems; Trajectory Optimization

19980056425

Nonlinear inverse simulation for the maneuvering flight of coaxial rotor helicopters

Cao, Yihua, Beijing Univ. of Aeronautics and Astronautics, China; Reichert, G., Braunschweig, Technical Univ., Germany; Chinese Journal of Aeronautics; Nov. 1997; ISSN 1000-9361; Volume 10, no. 4, pp. 239-246; In English; Copyright; Avail: Aeroplus Dispatch

The maneuvering flight governing equations for coaxial rotor helicopters are established. by introducing induced velocity interference factor analysis, the coaxial rotor aerodynamic interference can be taken into account. With the combination of coaxial rotor helicopter control features and nonlinear inverse solution technique, the governing equations for maneuvering flight can be solved so as to determine helicopter control input, control force and moment, and helicopter body attitudes which are needed for performing the defined maneuver. Finally, as an example of this method’s engineering application, the calculated results with level turn, lateral jink maneuvers are presented and simply analyzed.
Author (AIAA)
Aircraft Maneuvers; Rotary Wings; Helicopters; Flight Simulation

19980056654

Developing a thrust vectoring system for transport aircraft

Aerospace Engineering; Feb. 1998; ISSN 0736-2536; Volume 18, n, nos. 1-2, pp. 16, 17; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the stability/control systems being developed for a civil twin-turbofan VSTOL transport aircraft. Large thrust vectoring-induced control moments are required during the hover and transition regimes of such and aircraft because of the greater moments of inertia associated with high aspect ratio wing and long fuselage.
AIAA
Transport Aircraft; Thrust Vector Control; Control Systems Design; V/STOL Aircraft; Aircraft Stability; Slender Wings

19980057819

F-16 database terrain cueing - An investigation of display handling qualities

Christensen, Kevin, USAF, 416th Flight Test Squadron, USA; Weber, Gregory, USAF, 416th Flight Test Squadron, USA; Seelos, Michael, USAF, 416th Flight Test Squadron, USA; Gillen, Sean, Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp.

118-135; In English; Copyright; Avail: Aeroplus Dispatch

The Digital Terrain System (DTS) which is to be built into all F-16 aircraft is discussed. Two of the five functions of the DTS are examined, terrain referenced navigation and database terrain cueing (DBTC). Planned testing of the DBTC function is discussed.

AIAA

F-16 Aircraft; Data Bases; Display Devices; Aircraft Instruments

19980057826

Pilot recognition of the F/A-18 falling leaf mode

Zamka, George D., U.S. Navy, Naval Air Warfare Center, USA; Hyde, David C., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 253-266; In English; Copyright; Avail: Aeroplus Dispatch

The identification of the falling leaf mode of departure from controlled flight in the F/A-18 aircraft both in flight and on the ground using real-time telemetering data is studied. It is found that the Light in the seat With Sideforce (LWS) cue occurs in many of the F/A-18's demonstrated out-of-control modes and postdeparture gyrations. The cue correlates to a combination of low AOA and high sideslip and has a distinct pattern of occurrence for different departure and out-of-control modes. Pilot recognition of the cue and understanding of how LWS is related to out-of-control modes will allow for correct mode determination and proper application of controls.

AIAA

F-18 Aircraft; Aircraft Pilots; Flight Control; System Failures; Real Time Operation

19980057829

F-16 stability and control certification testing with digital flight control system improvements

Taschner, Michael J., USAF, F-22 System Program Office, USA; Janzen, Doyle B., USAF, Flight Test Center, USA; 1997, pp. 290-306; In English; Copyright; Avail: Aeroplus Dispatch

Risk management lessons learned are presented from an F-16 Block 40/50 stability and control certification flight test program. Departure resistance enhancements significantly improved the maneuvering limits of the F-16 with large air-to-air missile lateral asymmetries. However, post-departure characteristics following high-energy yaw departures proved problematic. Loadings with large lateral asymmetries and inlet pods demonstrated highly-dynamic upright spins. Deep stall recovery procedures were inadequate and on two occasions the spin chute was deployed to ensure aircraft recovery. Flight testing with inlet pods was suspended while test safety procedures were refined and an upright spin recovery procedure developed. The new procedures allowed successful completion of the program without further incident. Timeless risk management lessons were relearned in areas such as hazard identification, risk assessment when performance is near ultimate achievable levels, and developing viable risk control measures. Tough benefit-cost tradeoffs were made to balance user requirements with flight test risk.

Author (AIAA)

F-16 Aircraft; Aircraft Stability; Stability Tests; Aircraft Control; Optimal Control; Flight Tests

19980057831

Meeting the UK's future STOVL recovery requirements

Paines, Justin, DERA, UK; Stone, Paul, DERA, UK; 1997, pp. 323-337; In English; Copyright; Avail: Aeroplus Dispatch

The UK's future STOVL recovery requirements are reviewed in the light of Harrier VSTOL operations and the impact of the Harrier's unique VSTOL capabilities. A description of the Vectored-thrust Aircraft Advanced Control program and its background is followed by an account of the development and flight test of its major safety mechanism, the Independent Monitor (IM). Various STOVL lessons learned are recounted, with particular relevance to the renaissance in STOVL flight test which will accompany the development of the Joint Strike Fighter (JSF) STOVL variant. These lessons include the impact of performance limitations on jet-borne flight test and the unpredictability of the partially jet-borne STOVL transition regime. The choices to be faced in the design of advanced STOVL flight control are considered along with the balance between the benefits of highly automated digital flight control for STOVL and potential loss in pilot flexibility. Plans for future research are reviewed.

Author (AIAA)

STOVL Aircraft; Recovery Vehicles; Harrier Aircraft; Thrust Vector Control; Flight Tests; Flight Safety

19980057835

B-2A residual pitch oscillation (RPO) investigation

Moss, Christopher, USAF, 420th Flight Test Squadron, USA; Shifflett, Samuel, USAF, 420th Flight Test Squadron, USA; 1997, pp. 393-410; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the methods and some results of a low-altitude high-speed RPO investigation performed on the B-2A aircraft. It was found that the RPO was not due to flutter or the pitch control law, while Mach number, outboard fuel, cg, altitude, payload, and elevated load factor appeared to be important factors in RPO onset.
AIAA
B-2 Aircraft; Pitching Moments; Flight Altitude; Flutter Analysis

19980058423
Short-time spatial trajectories on-board optimization and their cognitive head-up display visualization for pilot's control actions during maneuvering support
Yakimenko, Oleg A., Military-Air Engineering Academy, Russia; 1997, pp. 246-256; In English; Copyright; Avail: Aeroplus Dispatch
There are considered in present paper the general aspects of mathematical foundation of on-board universal pilot's support system subsystem, which provides pilot's control actions support during more or less long-term maneuvers such as take-off and climbing, flight on a route, surface-based target attack (in case of military aircraft), descent and landing via shortcut-time spatial trajectories on-board optimization, and their head-up display in the view of 'road-in-the-sky' image visualization for its further tracking in direct with foresee regime or (semi) automatic mode. There are disclosed two specially designed for this purpose: 'fast' modifications of direct method of variational tasks solution - one (for short-term trajectories with strong restrictions on control functions) based on 5th-7th power polynomials optimal trajectory approximation, the second (for long-term flight on a rout trajectories) based on spline approximation. Both from a conditional arch argument, with obligatory satisfaction of phase coordinates and controls boundary conditions (a priori) and all limitations (in the process of optimization). The paper contains examples of a computer-based highly maneuverable airplane tactical simulator with a demonstrated prototype of the considered subsystem.
Author (AIAA)
Head-Up Displays; Aircraft Maneuvers; Aircraft Control; Aircraft Pilots; Trajectory Optimization; Display Devices

19980058864 Naval Undersea Warfare Center, Newport, RI USA
A Theoretical Control Study of the Biologically Inspired Maneuvering of a Small Vehicle Under a Free Surface Wave ***Final Report***
Singh, Sahjendra N., Nevada Univ., USA; Bandyopadhyay, Promode R., Department of the Navy, USA; Aug. 08, 1997; 27p; In English
Contract(s)/Grant(s): PR-97-WX-30344
Report No.(s): AD-A331255; NUWC-NPT-TR-10816; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report considers a theoretical control study of low-speed maneuvering of small underwater vehicles in the dive plane using dorsal and caudal fin-based control surfaces. The two dorsal fins are long and are actually mounted in the horizontal plane. The caudal fin is also horizontal and is akin to the fluke of a whale. Dorsal-like fins mounted on a flow aligned vehicle produce a normal force when they are cambered. Using such a device, depth control can be accomplished. A flapping foil device mounted at the end of the tailcone of the vehicle produces vehicle motion that is somewhat similar to the motion produced by the caudal fins of fish. The moment produced by the flapping foils is used here for pitch angle control. A continuous adaptive sliding mode control law is derived for depth control via the dorsal fins in the presence of surface waves. The flapping foils have periodic motion and they can produce only periodic forces. A discrete adaptive predictive control law is designed for varying the maximum tip excursion of the foils in each cycle for the pitch angle control and for the attenuation of disturbance caused by waves. The derivation of control laws requires only imprecise knowledge of the hydrodynamic parameters and large uncertainty in system parameters is allowed. In the closed-loop system, depth trajectory tracking and pitch angle control are accomplished using caudal and dorsal fin-based control surfaces in the presence of system parameter uncertainty and surface waves.
DTIC
Underwater Vehicles; Numerical Analysis; Maneuvers; Low Speed; Surface Waves

19980058867 Lehigh Univ., Dept. of Mechanical Engineering and Mechanics, Bethlehem, PA USA
Theoretical Investigation of Processes to Dynamic Stall and Control ***Final Report, Oct. 1993 - May 1997***
Walker, J. D. A., Lehigh Univ., USA; Sep. 20, 1997; 6p; In English
Contract(s)/Grant(s): F49620-93-1-0130
Report No.(s): AD-A331258; AFOSR-533040; AFOSR-TR-97-0561; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
The present work was mainly concerned with the fundamental processes that occur on a two-dimensional airfoil undergoing a maneuver which normally produces dynamic stall. The results show that, in a high Reynolds number flow, a separation process

initiates in the leading-edge region once a certain critical angle of attack is exceeded (for a thin airfoil). Much of the work has concentrated on the leading edge region, since a general analysis incorporating the effects of the airfoil wake has shown that for a thin airfoil at angle of attack, the most important separation effects occur in the leading edge region. A number of possible control processes have been considered on a computational basis of the leading-edge region, including selective localized suction and a small moveable portion of the wall. These indicate that the onset of separation can be inhibited at angles of attack beyond the critical value leading to significant increases in lift. Extensive computations have also been carried out for unsteady three dimensional boundary layers induced by vortex motion. The results show that complex separation events occur that involve complication topologies and multiple critical points. A Lagrangian method has been developed which computers the solution at high Reynolds number up to the evaluation of a separation singularity.
DTIC
Computational Fluid Dynamics; Aerodynamic Stalling; Boundary Layer Separation

19980059331

Tactical and strategic missile guidance (3rd revised and enlarged edition)

Zarchan, Paul, Charles Stark Draper Lab., Inc., USA; 1997; In English; ISBN 1-56347-254-6; Copyright; Avail: Aeroplus Dispatch

A text on tactical and strategic missile guidance is presented. The topics covered include: numerical techniques, fundamentals of tactical missile guidance, methods of adjoints and the homing loop, noise analysis, covariance analysis and the homing loop, proportional navigation and miss distance, digital fading memory noise filters, advanced guidance laws, Kalman filters and the homing loop, other forms of tactical guidance, tactical zones, strategic considerations, boosters, Lambert guidance, strategic intercepts, ballistic target properties, extended Kalman filtering and ballistic coefficient estimation, ballistic target challenges, multiple targets, weaving targets, representing missile airframe with transfer functions, introduction to flight control design, and three-loop autopilot.
AIAA
Missile Control; Textbooks

19980065468

Natural description of aircraft motion

Avanzini, Giulio, Rome I, Univ., Italy; de Socio, Luciano, Rome I, Univ., Italy; de Matteis, Guido, Turin Polytechnic Inst., Italy; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 229-233; In English; Copyright; Avail: Aeroplus Dispatch

Reference is made to the various approaches leading to the timescale separation in aircraft dynamics. A separation of the translational variables as slow states from the fast rotational ones is assumed as the starting point to show that the Frenet triad can be conveniently adopted to develop algebraic expressions for the trajectory dynamics of the aircraft. The solution of the aircraft motion is realized by first dividing the time domain into intervals, the duration of which is of the order of magnitude of the characteristic time of the slow dynamics. Then, slow states such as vehicle position and velocity are immediately obtained over the entire interval in the form of a series expansion. Finally, the equations of the fast subsystem are numerically integrated in the same interval. The accuracy and efficiency of the proposed procedure is discussed in comparison with the straight numerical integration of the full system of governing equations. The method lends itself to applications in trajectory optimization and inverse simulation problems.
Author (AIAA)
Flight Mechanics; Equations of Motion; Flight Paths; Aircraft Control; Flight Simulation

19980065470

Missile autopilot designs using H-infinity control with gain scheduling and dynamic inversion

Schumacher, Corey, USAF, Research Lab., USA; Khargonekar, Pramod P., Michigan, Univ., Ann Arbor; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 234-243; In English
Contract(s)/Grant(s): F49620-93-1-0246-DEF; Copyright; Avail: Aeroplus Dispatch

Two nonlinear controller designs are presented for a bank-to-turn, air-to-air missile. The first controller is a gainscheduled H-infinity design, and the second is a nonlinear dynamic inversion design using a two-timescale separation. We carried out a number of time- and frequency domain analysis procedures on the resulting designs, and tested their performance on a nonlinear simulation of the missile. We compared the controller designs for nominal performance, robustness to uncertainties in the aerodynamic coefficients, and sensitivity to measurement noise. The dynamic inversion controller was found to be significantly less robust to

aerodynamic uncertainty. Using a mu-analysis test on a linearization of the closed-loop dynamics with the dynamic inversion controller, we were able to find a destabilizing aerodynamic uncertainty for the full nonlinear system.
Author (AIAA)
Automatic Pilots; Missile Control; H-Infinity Control

19980065471
Minimum-time maneuvers of thrust-vectored aircraft
Lichtsinder, Arkadi, Rafael Armament Development Authority, Israel; Kreindler, Eliezer, Technion - Israel Inst. of Technology, Haifa; Gal-Or, Benjamin, Technion - Israel Inst. of Technology, Haifa; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 244-250; In English; Copyright; Avail: Aeroplus Dispatch

The new aircraft technology of thrust vectoring (TV) enables the execution of new types of poststall maneuvers. Aircraft agility and flight safety are greatly enhanced. The objective and main contribution of the present work are the suboptimal solution of minimum-time pitch-reversal (there and back) and yaw-reversal standard agility comparison maneuvers (SACOM). It is demonstrated that, due to asymmetric and coupling moments at high alpha and high beta, pure pitch and yaw maneuvers are impossible; a full six-degree-of-freedom model must be employed. A novel parametric two-stage suboptimization algorithm was developed to cope with the complexity of the optimal control problem. All four aerodynamic and three TV controls are simultaneously active in the execution of a low g load, nearly pure 80-deg pitch-reversal and a 30-deg yaw-reversal SACOM of an F-15B aircraft.
Author (AIAA)
Aircraft Maneuvers; Thrust Vector Control; Time Optimal Control

19980065472
Variable structure adaptive control of wing-rock motion of slender delta wings
Araujo, Aldayr D., Nevada, Univ., Las Vegas; Rio Grande do Norte, Federal Univ., Brazil; Singh, Sahjendra N., Nevada, Univ., Las Vegas; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 251-256; In English; Copyright; Avail: Aeroplus Dispatch

Based on the variable structure model reference adaptive control theory, a new control system for the control of wing-rock motion of slender delta wings, using only roll angle measurement, is designed. For the derivation of the control law, it is assumed that the aerodynamic parameters and the structure of the aerodynamic nonlinear functions in the model are unknown. Moreover, it is assumed that disturbance input due to wind gust is present in the system. It is shown that, in the closed-loop system designed using bounds on uncertain functions, the roll angle tracks given reference trajectory, and the wing-rock motion is suppressed. Digital simulation results show that the closed-loop system has good transient behavior and robustness to the uncertainties and disturbance input.
Author (AIAA)
Delta Wings; Slender Wings; Wing Rock; Adaptive Control; Aircraft Control

19980065489
Geometric approach to three-dimensional missile guidance problem
Chiou, Ying-Chwan, Aerospace Industrial Development Corp., Taiwan, Province of China; Kuo, Chen-Yuan, Arizona State Univ., Tempe; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 335-341; In English; Copyright; Avail: Aeroplus Dispatch

The Frenet-Serret formula in classical differential geometry curve theory and the characteristics of a fictitious missile pointing velocity vector are used to design missile guidance curvature command. Qualitative analysis is conducted to study capture capability of the designed guidance command in 3D engagements. The region that miss can occur is derived in terms of the tangential component of the kinematics equation. Then, a sufficient initial condition is derived, which, with the target's maneuvering information, can guarantee capture for an arbitrary target maneuver. to validate this capture conclusion, two simple missile torsion commands are introduced to rotate direction of the missile curvature command to ensure that the curvature command formula is well defined. Such a missile roll strategy may also help to improve capture capability in the final phase of an engagement.
Author (AIAA)
Missile Control; Three Dimensional Motion; Curves (Geometry)

19980065491
Analytical solution of missile terminal guidance
Takehira, Tetsuya, Michigan, Univ., Ann Arbor, USA; Vinh, Nguyen X., Michigan, Univ., Ann Arbor; Kabamba, Pierre T., Michi-

gan, Univ., Ann Arbor; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 342-348; In English; Copyright; Avail: Aeroplus Dispatch

A new guidance law that combines pursuit guidance and proportional navigation is proposed. This guidance law depends on two parameters that deterinine the relative importance of pursuit guidance and proportional navigation. Numerical simulations of the nonlinear equations of motion suggest that the parameters of this law can be chosen to reduce the peak value of the missile acceleration or the duration of the engagement. When the engagement ends in a tail chase, and linearization is valid, the linearized equations of motion lead to a confluent hypergeometric equation. This equation is solved in dosed form, in the general case where the target performs maneuvers such that its heading angle is a polynomial function of time. The analytical solution based on linearization and the numerical simulation of the nonlinear equations show good agreement.

Author (AIAA)

Missile Control; Pursuit Tracking; Terminal Guidance

19980066927

Design of robust control systems for a hypersonic aircraft

Marrison, Christopher I., Princeton Univ., USA; Stengel, Robert F., Princeton Univ., USA; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 58-63; In English; Copyright; Avail: Aeroplus Dispatch

Robust flight control systems are synthesized for the longitudinal motion of a hypersonic aircraft. Aircraft motion is modeled by nonlinear longitudinal dynamic equations containing 28 uncertain parameters. Each controller is designed using a genetic algorithm to search a design coefficient space; Monte Carlo evaluation at each search point estimates stability and performance robustness. Robustness of a compensator is indicated by the probability that stability and performance of the closed-loop system will fall within allowable bounds, given likely parameter variations. A stochastic cost function containing engineering design criteria (in this case, a stability metric together with 38 step-response metrics) is minimized, producing feasible control system coefficient sets for specified control system structures. This approach trades the likelihood of satisfying design goals against each other, and it identifies the plant parameter uncertainties that are most likely to compromise robustness goals. The approach makes efficient use of computational tools and broadly accepted engineering knowledge to produce practical control system designs.

Author (AIAA)

Control Systems Design; Hypersonic Aircraft; Flight Control; Aircraft Stability

19980066930

Modal multimodel control design approach applied to aircraft autopilot design

Le Gorrec, Yann, ONERA; SUPAERO, France; Magni, Jean-Francois, ONERA; SUPAERO, France; Doell, Carsten, ONERA; SUPAERO, France; Chiappa, Caroline, ONERA; SUPAERO, France; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 77-83; In English

Report No.(s): AIAA Paper 97-3624; Copyright; Avail: Aeroplus Dispatch

Modal approaches such as eigenstructure assignment have shown themselves to be efficient for flight control design. Performance requirements are easily met using this approach. However, generally, robustness is not satisfactory. A technique is presented that can be viewed as an improvement over traditional eigenstructure assignment, as it produces systems that meet robustness requirements (multimodel approach). The proposed technique reduces to solving a quadratic problem under linear constraints. The application treated concerns the landing phase of a large transport aircraft. It is shown that standard gain scheduling can be replaced by a single low-dimensional dynamic feedback.

Author (AIAA)

Modal Response; Control Systems Design; Automatic Pilots; Flight Control; Feedback Control; Transport Aircraft

19980066931

Vision-based position and attitude determination for aircraft night landing

Chatterji, Gano B., Sterling Software, USA; Menon, Padmanabhan K., Optimal Systems, USA; Sridhar, Banavar, NASA Ames Research Center, USA; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 84-92; In English; Copyright; Avail: Aeroplus Dispatch

An image-based method for the determination of aircraft position and yaw and pitch orientations with respect to the runway during night landing is described. Information derived from a model of the airport lights together with video images acquired by an onboard video camera and roll attitude angle sensed with a roll sensor are integrated in a Kalman filtering algorithm. Simulation results are presented to demonstrate the feasibility of the proposed concept.

Author (AIAA)

Aircraft Landing; Night Flights (Aircraft); Computerized Simulation; Position (Location); Attitude Control; Night Vision

19980066932

Rapid hover-to-forward-flight transitions for a thrust-vectored aircraft

Van Niewstadt, Michel J., California Inst. of Technology, Pasadena, USA; Murray, Richard M., California Inst. of Technology, Pasadena; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 93-100; In English
Contract(s)/Grant(s): NSF CMS-95-02224; F49620-95-1-0419; Copyright; Avail: Aeroplus Dispatch

The use of differential flatness for computation of a nominal trajectory for fast transition between flight modes of autonomous vehicles is investigated. Differential flatness of an approximate model of the longitudinal dynamics of a thrust-vectored aircraft is used to achieve fast switching between flight modes. We conclude that steering to the trimmed state of the full model is of crucial importance for good performance. Simulations and experimental data for a thrust-vectored flight-control experiment at Caltech are provided to validate the approach.
Author (AIAA)
Hovering; Thrust Vector Control; Trajectory Measurement; Flight Control

19980066933

Theory for roll-ratchet phenomenon in high-performance aircraft

Hess, Ronald A., California, Univ., Davis, USA; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 101-108; In English
Contract(s)/Grant(s): NAG1-1744; Copyright; Avail: Aeroplus Dispatch

Roll ratchet refers to a high-frequency oscillation that can occur in pilot-in-the-loop control of roll attitude in high-performance aircraft. The frequencies of oscillation typically are well beyond those associated with the more familiar pilot-induced oscillation. A structural model of the human pilot, which has been employed to provide a unified theory for aircraft handling qualities and pilot-induced oscillations, is employed here to provide a theory for the existence of roll ratchet. It is hypothesized and demonstrated using the structural model that the pilot's inappropriate use of vestibular acceleration feedback can cause this phenomenon, a possibility that has been discussed by other researchers. The possible influence of biodynamic feedback on roll ratchet also is discussed.
Author (AIAA)
Roll; Aircraft Performance; Aircraft Control; High Frequencies

19980066947

Translational motion control of vertical takeoff aircraft using nonlinear dynamic inversion

Patel, Yoge, Defence Evaluation and Research Agency, UK; Smith, Phill R., Defence Evaluation and Research Agency, UK; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 179-182; In English; Copyright; Avail: Aeroplus Dispatch

Novel nonlinear dynamic inversion (NDI) control laws are here developed for the translational modes required to maneuver vertical/short takeoff and landing (V/STOL) aircraft in hover and in forward flight. The dynamical responses that are ultimately decoupled and prescribed by these control laws are the aircraft translational accelerations in body axes; the control laws determine the forces required to achieve translational accelerations, velocities, and position. Application is demonstrated using off-line simulation of a V/STOL aircraft.
AIAA
Vertical Takeoff; V/STOL Aircraft; Dynamic Response; Aircraft Control; Translational Motion

19980066949

Linearization of a six-degree-of-freedom missile for autopilot analysis

Bar-on, Jonathan R., Hughes Missile Systems Co., USA; Adams, Robert J., Hughes Missile Systems Co., USA; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 184-187; In English; Copyright; Avail: Aeroplus Dispatch

The equations required for obtaining a linear time-invariant model of a fully coupled, high angle-of-attack, six degree-of-freedom symmetric missile in trim are presented. A technique for determining the initial roll rates consistent with the dynamic equations of a trimmed missile are given, and it is shown that both the initial roll rates and the equations for the linear model are valid, with and without propulsive forces.
AIAA
Degrees of Freedom; Automatic Pilots; Linearization; Missile Design

19980067075

Performance improvement of a high gain PI controller by means of a scheme of antiwindup of the integrator

Chen, Chuande, Nanjing Univ. of Aeronautics and Astronautics, China; Xin, Ming, Nanjing Univ. of Aeronautics and Astronautics, China; Li, Yuan, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1005-2615; Volume 29, no. 4, pp. 469-473; In Chinese; Copyright; Avail: Aeroplus Dispatch

This note investigates the saturation nonlinear effect on the high gain error-actuated proportional-integral controller designed by means of the Salford singular perturbation method. After analyzing the cause of the deterioration of system performance, an antiwindup scheme is suggested to reduce this effect and take AFTI/F-16 direct force control system as an example to prove that the scheme is feasible and efficient.

Author (AIAA)

Nonlinear Systems; Flight Control; F-16 Aircraft

19980067551

Efficient treatment of moderate amplitude constraints for helicopter handling qualities design optimization

Sahasrabudhe, Vineet, Maryland, Univ., College Park, USA; Celi, Roberto, Maryland, Univ., College Park; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 730-739; In English

Contract(s)/Grant(s): DAAH04-94-G-0074; Copyright; Avail: Aeroplus Dispatch

This paper describes a new technique for the calculation of gradients of constraints associated with the moderate amplitude criteria of the ADS-33 helicopter handling qualities specifications. The gradients are calculated using low-order linear approximations to the full nonlinear model of the helicopter. The low-order models approximate the gradients well and reduce the additional cost of calculating the gradient by a factor of about 50. Most of the reduction in the objective function obtainable using the exact gradients are retained, with no additional unfeasible intermediate designs. The accuracy of linear Taylor-series expansions of the constraint in terms of the design variables is found to depend on the size of the changes of each design variable. The accuracy is not improved by using intermediate design variables, such as reciprocals and cubes of the design variables, but it improves if the bandwidth or derivative ratios are used as intermediate variables in the expansions.

Author (AIAA)

Helicopter Design; Flight Control; Aeroelasticity; Taylor Series

19980067555

Maneuvering flight performance using the linearized propeller polar

Lowry, John T., Flight Physics, USA; Journal of Aircraft; Dec. 1997; ISSN 0021-8669; Volume 34, no. 6, pp. 764-770; In English; Copyright; Avail: Aeroplus Dispatch

Fixed-pitch, propeller-driven, quasi-steady-state wings-level aircraft performance calculations are made simply and realistically by employing the linearized propeller polar formulation. This analysis extends that earlier treatment to banked turns and steady maneuvering. Building on the wings-level theory, it is useful to consider an absolute banked ceiling, the highest altitude at which the airplane can maintain level flight when banked through a particular angle. Because the linearized propeller polar (or bootstrap approach) is composed of such simple formulas, it is easy to construct a steady maneuvering diagram, giving the pilot immediate visualization of the relations among airspeed, bank angle, load factor limit, banked stall speed, rate of climb or descent, and either turning radius or rate. A precise prescription for constructing such a steady maneuvering diagram is given. For level turns, expressions for minimum turn radius and maximum turning rate are also given. It is found that these expressions for optimum turns are operational and not overshadowed by banked stall speed limits. It is concluded that this extended linearized propeller polar analysis is easy to calculate and visualize and that it should be used more extensively in both pilot training and aircraft operations.

Author (AIAA)

Aircraft Maneuvers; Flight Characteristics; Propeller Efficiency; Turning Flight; Wing Profiles

19980067706

Closed-loop HIRF experiments performed on a fault tolerant flight control computer

Belcastro, Celeste M., NASA Langley Research Center, USA; 1997, pp. 4.1-40 to 4.1-54; In English; Copyright; Avail: Aeroplus Dispatch

Closed-loop high-intensity radiated fields (HIRF) experiments were performed on a fault-tolerant flight control computer (FCC) at NASA-Langley. The FCC used in the experiments was a quad-redundant flight control computer executing B737 Autoland control laws. The FCC was placed in one of the mode-stirred reverberation chambers in the HIRF Laboratory and interfaced to a computer simulation of the B737 flight dynamics, engines, sensors, actuators, and atmosphere in the Closed-Loop Systems

Laboratory. Disturbances to the aircraft associated with wind gusts and turbulence were simulated during tests. Electrical isolation between the FCC under test and the simulation computer was achieved via a fiber-optic interface for the analog and discrete signals. Closed-loop operation of the FCC enabled flight dynamics and atmospheric disturbances affecting the aircraft to be represented during tests. Upset was induced in the FCC as a result of exposure to HIRF, and the effect of upset on the simulated flight of the aircraft was observed and recorded. We present a description of the closed-loop HIRF experiments, upset data obtained during these experiments, and closed-loop effects on the simulated flight of the aircraft.
Author (AIAA)
Fault Tolerance; Flight Control; Numerical Control; Airborne/Spaceborne Computers; Electromagnetic Radiation; Commercial Aircraft

19980067763

Low-level flight capability of a future military transport aircraft based on commercial avionics

Kricke, K. D., Daimler-Benz Aerospace Airbus GmbH, Germany; Schaefer, Dirk, Daimler-Benz Aerospace Airbus GmbH, Germany; 1997, pp. 7.2-24 to 7.2-32; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a system concept for low-level flight capability based on commercial avionics as used in AIRBUS aircraft. The essential functions and features of the flight control and flight guidance system are highlighted. The additional functions and system elements related to controls/displays and operational modes, which are required for low-level flight, are discussed. The first results of a demonstration and pilot evaluation performed in the flight simulator at Daimler-Benz Aerospace Airbus in Hamburg are presented.
Author (AIAA)
Military Aircraft; Transport Aircraft; Avionics; Automatic Flight Control; Fly by Wire Control

19980067764

In-flight transport performance optimization - An experimental flight research program and an operational scenario

Gilyard, Glenn, NASA, USA; 1997, pp. 7.2-33 to 7.2-49; In English; Copyright; Avail: Aeroplus Dispatch

A flight research program exploring the practical application of real-time performance optimization based on aircraft measurements and calculation of incremental drag from forced-response maneuvers is presented. The outboard ailerons of the L-1011 test bed aircraft were modified to provide for symmetric deflections to permit a recambering of the wing in that localized area, which in turn modifies the entire wing load distribution. NASA developed an onboard research engineering test station from which the flight experiments are conducted, and all analyses, both qualitative and quantitative, are performed in a real-time or near real-time manner. Initial flight test results are presented that indicate real-time drag minimization is attainable. An approach to an operational implementation of adaptive performance optimization on current and future commercial and military transports is discussed with the goal of keeping the required modifications simple and the pilot interface minimal and user-friendly.
Author (AIAA)
Aircraft Performance; Real Time Operation; Aircraft Maneuvers; Drag Reduction; Transport Aircraft; Optimization

19980067767

It works and it's affordable - Low cost distributed aircraft control systems

Todd, John R., Boeing Co., USA; 1997, pp. 7.3-26 to 7.3-30; In English; Copyright; Avail: Aeroplus Dispatch

This paper considers what why fly-by-light and fiber optic based aircraft sensors and data transfer technology has not yet fulfilled its vision. Additionally, current efforts to use commercial off-the-shelf hardware to reduce costs and standardize systems are described.
Author (AIAA)
Low Cost; Aircraft Control; Fiber Optics; Fly by Light Control

19980067941

Aircraft flight control system design under state and control bounds

Lyshevski, Sergey E., Purdue Univ., USA; IEEE Transactions on Aerospace and Electronic Systems; Jan. 1998; ISSN 0018-9251; Volume 34, no. 1, pp. 257-263; In English; Copyright; Avail: Aeroplus Dispatch

This work presents a systematic control design philosophy for flight control systems when the state variables and control inputs are bounded by the prespecified constraints. The design procedure uses the dynamic programming concept. The fundamental idea involves minimization of nonquadratic functionals. A new representation of constraints is proposed using the smooth func-

tions. The advantages of the synthesis approach are presented. to illustrate the design methodology, the longitudinal control configuration for the F-18 fighter is synthesized.
Author (AIAA)
Aircraft Control; Flight Control; MIMO (Control Systems); Control Systems Design; F-18 Aircraft

19980068005

Effect of the seas on the landing flare path of a seaplane (longitudinal motion) ***Vliyanie volneniya morya na postroenie traektorii vyravnivaniya pri posadke gidrosamoleta /prodol'noe dvizhenie/***

Rozhchenko, E. E., Moskovskij Gosudarstvennyj Tekhnicheskij Univ., Russia; Seriya Priborostroenie; Mar. 1997; ISSN 0236-3933, no. 1, pp. 80-86; In Russian; Copyright; Avail: Aeroplus Dispatch

The problem of estimating the safe height at the end of the flare maneuver of a seaplane based on the seas is considered. The approach proposed here is based on a statistical analysis of the group properties of waves using the data of full-scale experiments. The approach makes it possible to obtain a simple expression that relates the unknown height to the mean wave height.
AIAA
Hydroplanes (Vehicles); Sea Roughness; Trajectory Analysis; Water Landing; Water Waves

19980068190

Airplane stability and cotrol: A history of the technologies that made aviation possible

Abzug, Malcolm J., ACA Systems, USA; Larrabee, E. E., MIT, USA; 1997; In English; ISBN 0-521-55236-2; Copyright; Avail: Aeroplus Dispatch

This book is an informal popular survey of the art and science of airplane stability and control. As history, the growth and understanding of the subject is traced from the pre-Wright brothers days up to the present. The book is arranged only roughly in chronological order. Most of the chapters are thematic, dealing with a single subject over its entire history. The first twelve chapters cover the early developments in stability and control, teachers of and textbooks and conferences on stability and control, flying qualities and its evolution into a science, power effects on stability and control, managing control forces, stability and control at the design stage, jet aircraft at an awkward age, the discovery of inertial coupling, spinning and recovery, tactical airplane maneuverability, high Mach number difficulties, and naval aircraft problems. The final twelve chapters cover ultra-light and human-powered airplanes, fuel slosh, deep stall, ground effect, flutter, stability derivatives, safe personal airplanes, stability and control issues with variable sweep, modern canard configurations, the evolution of the equations of motion, the elastic airplane, stability augmentation, the current status of flying qualities research, the challenge of stealth aerodynamics, very large aircraft, and a brief outline of fundamental airplane stability and control areas that seem to have been bypassed but still require further research to be done.
AIAA
Aircraft Stability; Aircraft Control; Histories; Technology Assessment

19980068696

Methodology of flying qualities analysis in atmospheric disturbances

Khan, Sherzada, Beijing Univ. of Aeronautics and Astronautics, China; Xiao, Yelun, Beijing Univ. of Aeronautics and Astronautics, China; 1997, pp. 227-234; In English; Copyright; Avail: Aeroplus Dispatch

The response of an aircraft to atmospheric disturbances is an important aspect of its flying qualities. Atmospheric disturbances are very complicated meteorological phenomena. For the purpose of analysis of flying qualities, the atmospheric disturbances can be divided in three categories: turbulence, gust, and wind shear. This paper defines these three categories of atmospheric disturbances and separately analyses the effects of these disturbances. It describes the spectral characteristics of atmospheric turbulence and explains the mathematical models to represent turbulence, gust, and wind shear. It discusses the applicable methods for analysis of aircraft response to atmospheric disturbances from flight dynamics point of view. The methods discussed are: analytical method, numerical simulation, and flight simulator. It points out the limitations and possible applications of each method.
Author (AIAA)
Methodology; Atmospheric Turbulence; Flight Characteristics; Wind Shear

19980068699

Modeling of aerodynamic uncertainties and robust flight control system designs

Ieko, Tohru, National Defense Academy, Japan; Kondoh, Hiroyuki, National Defense Academy, Japan; Inoue, Yoshihiro, National Defense Academy, Japan; Ochi, Yoshimasa, National Defense Academy, Japan; Kanai, Kimio, National Defense Academy, Japan; 1997, pp. 243-250; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a modeling method for the uncertainties of the aerodynamic coefficients in a linear time-invariant aircraft model. The modeling method is applied to the structure of the perturbation in mu-synthesis, where the method deals with the variations of the altitude and the velocity as repeated scalar structures. A simulation study is carried out to illustrate the effectiveness of the proposed method. In the simulation results it is represented that the proposed method is less conservative than the method which assumes that each aerodynamic coefficient is individually perturbed. Consequently, the proposed method satisfies the robust performance for a wider envelope.
Author (AIAA)
Flight Control; Systems Engineering; Control Systems Design

19980068701
Gain scheduling flight control system for a high performance aircraft
Kuramochi, Tadashi, National Defense Academy, Japan; Kanai, KImio, National Defense Academy, Japan; 1997, pp. 259-265; In English; Copyright; Avail: Aeroplus Dispatch

In the case of designing controllers for parameter varying systems using the frozen parameter method or other similar methods, it is impossible to guarantee required performance and stability of the system that has rapidly varying parameters. This paper describes a method designing an H-infinity state feedback controller considering the parameter varying rate for the lateral-directional motion of a high-performance aircraft.
Author (AIAA)
Scheduling; Flight Control; Aircraft Control; Control Systems Design; Linear Systems

19980068703
Semi-active flutter control by structural asymmetry
Liu, Hongjun, Northwestern Polytechnical Univ., China; Yang, Zhichun, Northwestern Polytechnical Univ., China; Zhao, Lingcheng, Northwestern Polytechnical Univ., China; 1997, pp. 271-274; In English; Copyright; Avail: Aeroplus Dispatch

A semi-active flutter suppression scheme is developed using feedback control of the store junction stiffness to change the symmetric external store configuration to asymmetric, thus stopping flutter occurrence. The scheme is verified by both numerical simulation and wind tunnel tests.
Author (AIAA)
Flutter; Vibration Damping; Wind Tunnel Tests; Aeroelasticity; Active Control

19980068704
Nonlinear flight control system design for ALFLEX using inverse dynamics
Ohta, Hirobumi, Osaka Prefecture Univ., Japan; Sunasawa, Sakushi, Nagoya Univ., Japan; 1997, pp. 275-282; In English; Copyright; Avail: Aeroplus Dispatch

The dynamic characteristics of the ALFLEX (AutoLanding FLight EXperiment) vehicle experience larger variations than those of conventional fixed-wing airplanes, and its equations of motion exhibit strong nonlinearity because of its particular body form and drastic changes of flight environment. As a test to control the vehicle with a single controller, the design of a flight control system using the inverse dynamics transformation and singular perturbation method is discussed and its performance is examined with simulations for ALFLEX.
Author (AIAA)
Flight Control; Systems Engineering

19980068705
Exact solution of H-infinity optimal controllers with time delay
Ohta, Hirobumi, Osaka Prefecture Univ., Japan; Tokutake, Hiroshi, Osaka Prefecture Univ., Japan; Ito, Toshio, Nagoya Univ., Japan; 1997, pp. 283-289; In English; Copyright; Avail: Aeroplus Dispatch

An H-infinity optimal controller considering time-delay is solved explicitly for roll angle control using aileron control surfaces. 'Explicit' means that the time-delay is treated as it is without using approximation in the frequency domain. A robust stabilization problem for multiplicative uncertainties is chosen as a formulation, and an explicit H-infinity optimal controller for this problem is solved analytically. Stability and performance of the controller are examined for parameter variations.
Author (AIAA)
H-Infinity Control; Optimal Control; Time Lag; Maneuverability; SISO (Control Systems)

19980068734

N250-PA1 in-flight low speed pitot static, angle of sideslip and angle of attack calibrations using Inertial Navigation System (INS)

Derajat, Ajat, IPTN Indonesian Aircraft Industries, Indonesia; Djulaini, Vonny A., IPTN Indonesian Aircraft Industries, Indonesia; 1997, pp. 444-449; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes an in-flight calibration method using a mathematical approximation model of state variables sensed by an INS. The method is intended for calibrating pitot static systems, angle of sideslip, and angle of attack. The low-speed position error correction and angle of sideslip are calculated from the relationship between ground speed, wind speed, and true airspeed vector. Angle of attack is determined using its relationship with pitch angle and flight path angle. Ground speed, pitch angle, and flight path angle are sensed by INS. The calibration method is applied using the IPTN N250-PA1 test data. The accuracy of the results is estimated using the error propagation method. From the test results, it can be concluded that the INS can be used as inflight calibration equipment.

Author (AIAA)

Inertial Navigation; Calibrating; Angle of Attack; Sideslip

19980068735

The application of complex-curve fitting method for N250-PA1 Flight Flutter Test program

Suliantoro, Hery, IPTN Indonesian Aircraft Industries, Indonesia; Widayanti, Rukmi, IPTN Indonesian Aircraft Industries, Indonesia; 1997, pp. 450-455; In English; Copyright; Avail: Aeroplus Dispatch

The objective of Flight Flutter Test is to demonstrate that flutter does not occur until its maximum design speed and to determine the flutter speed of the aircraft. The flutter speed can be obtained by evaluating dynamic characteristics of the aircraft. The dynamic characteristics of the aircraft are evaluated at a certain lower speed and the result is used to predict the characteristic at higher speeds. to carry-out Flight Flutter Test as efficiently as possible, the prediction of the dynamic characteristics of the aircraft at higher speed has to be done quickly. Indonesian Aircraft Industries has developed a software to achieve this purpose. This paper presents the mathematical details of the software using the complex-curve fitting method. Some examples are given for the N250-PA1 flight test data. Determination of flutter speed from the dynamic characteristics of the aircraft using the Zimmerman method is briefiy discussed.

Author (AIAA)

Curve Fitting; Flutter; Free Flight

19980068956

Longitudinal control of an advanced combat aircraft using quantitative feedback theory

Breslin, S. G., Strathclyde, Univ., UK; Grimble, M. J., Strathclyde, Univ., UK; 1997, pp. 113-117; In English; Copyright; Avail: Aeroplus Dispatch

A robust controller is designed for the pitch rate control system of an Advanced Combat Aircraft for a section of the flight envelope over which there is a significant variation in the aircraft dynamics. The QFT methodology is reviewed and the links between H-infinity control theory explored. The design results are compared with previous studies using H-infinity synthesis, and it is shown how improved results can be obtained using the results of the quantitative analysis.

Author (AIAA)

Fighter Aircraft; Longitudinal Control; Control Systems Design; H-Infinity Control

19980068958

On the design of LPV controllers for the F-14 aircraft lateral-directional axis during powered approach

Balas, Gary J., Minnesota, Univ., Minneapolis, USA; Fialho, Ian, Minnesota, Univ., Minneapolis; Packard, Andy, California, Univ., Berkeley; Renfrow, Joe, U.S. Navy, Naval Air Warfare Center, USA; Mullaney, Chris, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 123-127; In English

Contract(s)/Grant(s): N00421-94-R-0094; Copyright; Avail: Aeroplus Dispatch

This paper presents the preliminary design and testing of a linear parameter-varying (LPV) controller for the F-14 aircraft lateral-directional axis. The controller is designed for the powered approach flight envelope, which consists of angle-of-attack/airspeed variations from 2 deg/182 knots to 14 deg/126 knots. The design is based on four linearized models at 2, 6, 10.5, and 14 deg angle-of-attack. The resulting LPV controller performs well when implemented in a Simulink nonlinear simulation of the F-14

aircraft, in the full order FORTRAN nonlinear simulation, and in pilot-in-the-loop simulations at the Naval Air Warfare Center at Patuxent River, Maryland.
Author (AIAA)
F-14 Aircraft; Control Systems Design; Lateral Control; Directional Control

19980068959
Linear fractional transformation control of the F-14 aircraft lateral-directional axis during powered approach landing
Fialho, Ian, Minnesota, Univ., Minneapolis, USA; Balas, G., Minnesota, Univ., Minneapolis; Packard, Andy, California, Univ., Berkeley; Renfrow, Joe, U.S. Navy, Naval Air Warfare Center, USA; Mullaney, Chris, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 128-132; In English
Contract(s)/Grant(s): N00421-94-R-0094; Copyright; Avail: Aeroplus Dispatch

This paper presents the design of a linear fractional transformation (LFT) gain-scheduled controller, scheduled on angle-of-attack, for the F-14 aircraft lateral-directional axis. The controller is designed for the powered approach flight envelope during which angle-of-attack/airspeed variations range from 2 deg/182 knots to 14 deg/126 knots. A linear fractional model of the lateral dynamics is constructed based on four linearized models that correspond to 2, 6, 10.5, and 14 deg angle-of-attack. The resulting LFT controller performs well when implemented in a Simulink nonlinear simulation of the F-14 aircraft.
Author (AIAA)
F-14 Aircraft; Lateral Control; Linear Transformations; Directional Control; Approach Control; Automatic Gain Control

19980068960
MMAE-based control redistribution applied to the VISTA F-16
Stepaniak, Michael J., USAF, Inst. of Technology, USA; Maybeck, Peter S., USAF, Inst. of Technology, USA; 1997, pp. 133-139; In English; Copyright; Avail: Aeroplus Dispatch

A novel control technique, termed ’control redistribution’, is presented and applied in conjunction with multiple model adaptive estimation (MMAE) to the Variable In-flight Stability Test Aircraft (VISTA) F-16, to detect and compensate for sensor and/or actuator failures. This ad hoc method redistributes control commands (that would normally be sent to failed actuators) to the non-failed actuators, accomplishing the same control action on the aircraft. Dither is considered to help disambiguate failures in the longitudinal and lateral-directional channels. Detection of both single-actuator and single-sensor failures is considered. Failures are demonstrated detectable in less than one second, with an aircraft output nearly identical to that anticipated from a fully functional aircraft in the same environment.
Author (AIAA)
F-16 Aircraft; Aircraft Control; Adaptive Control; Aircraft Stability; Stability Tests

19980068961
Nonlinear H-infinity flight control
Yang, Ciann-Dong, National Cheng Kung Univ., Taiwan, Province of China; Kung, Chien-Chung, National Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 140-144; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the application of nonlinear H-infinity state feedback theory to flight control. We divide the flight control into attitude control and velocity control, which are different from the conventional longitudinal and lateral control. The new control framework, which is based on nonlinear H-infinity state feedback theory, solves the 6 D aircraft governing equations directly without linearization. This new flight control methodology has the separation property where we can design the attitude controller and the velocity controller independently. Moreover, it can be shown that controller design can be done before parameter identification of the aircraft.
Author (AIAA)
Flight Control; Control Theory; Control Systems Design; H-Infinity Control; Feedback Control

19980068985
Nonlinear control of agile missiles using state dependent Riccati equations
Wise, Kevin A., McDonnell Douglas Aerospace, USA; Sedwick, Jackson L., McDonnell Douglas Aerospace, USA; 1997, pp. 379, 380; In English
Contract(s)/Grant(s): F49620-92-C-0057; Copyright; Avail: Aeroplus Dispatch

This study describes an H-infinity-based approach using a state dependent Riccati equation (SDRE). The present approach was taken from Wise et al. (1993), and was developed to solve for a nonlinear H-infinity control that satisfied the Hamilton-Jacobi-Isaacs partial differential equation.
Author (AIAA)
Riccati Equation; Missile Control; Hamilton-Jacobi Equation; H-Infinity Control

19980069035
Dynamic robust recursive control design and its application to a nonlinear missile autopilot
Hull, Richard A., Sverdrup Corp., USA; Qu, Zhihua, Central Florida, Univ., USA; 1997, pp. 833-837; In English; Copyright; Avail: Aeroplus Dispatch

A new design method is proposed, dynamic robust recursive control, in order to obtain output tracking performance for a general class of nonlinear systems. Depending on the relative degree of the system, this new approach generates static or dynamic controllers, whereas previous recursive design methods generate only static controllers. The dynamic recursive technique does not require any prior conditions on the system structure and hence overcomes the main limitation of the backstepping method. Robust dynamic recursive design is extended to uncertain nonlinear systems which do not satisfy either the matching conditions or the generalized matching conditions. System uncertainty is modeled in the time domain, and the design of robust fictitious control terms in the recursive design process requires only that suitable bounding functions are imposed on the uncertainty. A detailed case study is developed to demonstrate the application of the dynamic robust recursive design method to a second-order nonlinear 'pitch plane' missile autopilot with structured uncertainties.
Author (AIAA)
Automatic Pilots; Control Systems Design; Missile Control

19980069072
Adaptive critic based neurocontroller for autolanding of aircraft
Saini, Gaurav, Missouri-Rolla, Univ., Rolla, USA; Balakrishnan, S. N., Missouri-Rolla, Univ., Rolla; 1997, pp. 1081-1085; In English; Copyright; Avail: Aeroplus Dispatch

Adaptive critic based neural networks have been used to design a controller for a benchmark problem in aircraft autolanding. The adaptive critic control methodology comprises successive adaptations of two neural networks, namely 'action' and 'critic' network (which approximate the Hamiltonian equations associated with optimal control theory) until closed loop optimal control is achieved. The autolanding problem deals with longitudinal dynamics of an aircraft which is to be landed in a specified touchdown region (within acceptable ranges of speed, pitch angle, and sink rate) in the presence of wind disturbances and gusts using elevator deflection as the control for glide-slope and flare modes. The performance of the neurocontroller is compared to that of a conventional proportional-integral-differential (PID) controller. The results show that the neurocontrollers have good potential for aircraft applications.
Author (AIAA)
Controllers; Neural Nets; Adaptive Control; Aircraft Landing; Landing Aids; Automatic Landing Control

19980069075
4D air traffic control for non-4D-equipped aircraft
Jardin, M. R., NASA Ames Research Center, USA; 1997, pp. 1101-1108; In English; Copyright; Avail: Aeroplus Dispatch

Current concepts for 4D time-based ATC automation systems are generally designed to control aircraft so that they cross a final control waypoint at a scheduled time, but the trajectory between the initial waypoint and the control waypoint is not explicitly specified. Instead of this type of single-point 4D control, it may be advantageous to use closed-loop control to reference 4D trajectories. The design of a compensator to help air traffic controllers and pilots accurately and efficiently control aircraft to buffered 4D reference trajectories is presented. The main technical challenge is to develop a control algorithm that efficiently achieves 4D control for aircraft while maintaining acceptable controller workload levels. The approach is to soften 4D trajectory clearances by allowing aircraft to be within a well-defined error buffer region around the trajectory and to try and synchronize advisory updates with the reference trajectory advisories such that the aircraft remains within the buffer. A bias estimator is used to remove steady-state errors. The control algorithms are developed and a simple example of a 4D control scenario is presented.
Author (AIAA)
Air Traffic Control; Automatic Control; Aircraft Control; Compensators

19980069076

Disturbance gain and bandwidth margins - Definitions and application to autopilot design

Davison, D. E., Michigan, Univ., Ann Arbor, USA; Kabamba, P. T., Michigan, Univ., Ann Arbor; Meerkov, S. M., Michigan, Univ., Ann Arbor; 1997, pp. 1109, 1110; In English

Contract(s)/Grant(s): DAAL03-92-G-0127; Copyright; Avail: Aeroplus Dispatch

This paper deals with the notion of disturbance model uncertainty. The disturbance is modeled as the output of a first-order filter which is driven by white noise and whose bandwidth, omega(b), and H2-norm, K, are uncertain. An analytical expression for the steady-state output variance as a function of omega(b) and K is derived. Several properties of this variance function are given and the notions of disturbance gain margin and disturbance bandwidth margin are introduced. These tools are then applied to the analysis of an altitude hold autopilot system in the presence of turbulence with uncertain turbulence scale.

Author (AIAA)

Bandwidth; Automatic Pilots; Perturbation; Control Systems Design

19980069077

Maneuvering flight control

Pachter, M., USAF, Inst. of Technology, USA; Chandler, P. R., USAF, Wright Lab., USA; Smith, L., USAF, Wright Lab., USA; 1997, pp. 1111-1115; In English; Copyright; Avail: Aeroplus Dispatch

The development of control laws for maneuvering flight, specifically, a high amplitude velocity vector roll is addressed. The plant model has seventh order nonlinear dynamics with coupled pitch and lateral directional dynamics. Using time scale separation and pointwise linearization, a receding horizon linear quadratic optimal control law with full state feedback is synthesized on-line. Also on-line, the pilot inputs are modulated using linear programming to prevent actuator rate saturation over the optimization horizon. The nonlinear control law performance is demonstrated in a fighter aircraft simulation with a rudder failure during a loaded roll maneuver.

Author (AIAA)

Flight Control; Aircraft Maneuvers; Control Theory; Roll; Control Systems Design; Lateral Control

19980069078

Supplemental control for robust flight cruise in turbulent time windows

Ashokkumar, C. R., North Carolina A & T State Univ., Greensboro, USA; Homaifar, A., North Carolina A & T State Univ., Greensboro; Williams, Rolanda, North Carolina A & T State Univ., Greensboro; 1997, pp. 1116-1120; In English

Contract(s)/Grant(s): NCC4-105; Copyright; Avail: Aeroplus Dispatch

Turbulence during flight cruise is known to prevail over discrete time windows. The control surface deflections to recover ride quality at these time windows are important, specifically in high-speed cruise vehicles. In this paper, we assume that the turbulence is measurable as an impulse of known intensity at a given time instant and provide simple formulas for the supplemental control impulse, minimizing its effect on ride quality. These thumb rules are particularly useful to evaluate the desired ride quality metrics, control magnitudes etc., at the time instances during which the flight cruise is felt with turbulence. In the high speed civil transport type of vehicles, these magnitudes are critical and may be discontinuous with respect to the nominal flight cruise.

Author (AIAA)

Cruising Flight; Atmospheric Turbulence

19980069123

Output tracking with nonhyperbolic and near nonhyperbolic internal dynamics - Helicopter hover control

Devasia, Santosh, Utah, Univ., Salt Lake City, USA; 1997, pp. 1439-1446; In English

Contract(s)/Grant(s): NAG2-1042; Copyright; Avail: Aeroplus Dispatch

A technique to achieve output tracking for nonminimum phase linear systems with nonhyperbolic and near nonhyperbolic internal dynamics is presented. This approach integrates stable inversion techniques that achieve exact tracking with approximation techniques that modify the internal dynamics to achieve desirable performance. Such modification of the internal dynamics is used (1) to remove nonhyperbolicity which is an obstruction to applying stable inversion techniques and (2) to reduce large preactuation times needed to apply stable inversion for near nonhyperbolic cases. The method is applied to an example helicopter hover control problem with near-nonhyperbolic internal dynamics for illustrating the tradeoff between exact tracking and reduction of preactuation time.

Author (AIAA)

Helicopter Control; Tracking (Position); Feedback Control

19980069293

A comparison of missile autopilot designs using H-infinity control with gain scheduling and nonlinear dynamic inversion

Schumacher, Corey, Michigan, Univ., Ann Arbor, USA; Khargonekar, Pramod P., Michigan, Univ., Ann Arbor; 1997, pp. 2759-2763; In English; Copyright; Avail: Aeroplus Dispatch

In this paper, we present two nonlinear controller designs for a bank-to-turn air-to-air missile. The first controller is a gain-scheduled H-infinity design, and the second is a nonlinear dynamic inversion design using a two-time scale separation. We carried out a number of time and frequency domain analysis procedures on the resulting designs and tested their performance on a nonlinear simulation of the missile. We compare the controller designs for nominal performance, robustness to uncertainties in the aerodynamic coefficients, and sensitivity to measurement noise.

Author (AIAA)

Missile Control; Automatic Pilots; Control Systems Design; H-Infinity Control; Air to Air Missiles; Flight Control

19980069295

Autopilot design for BTT missiles using receding horizon predictive control scheme

Kim, Myung-Joon, Seoul National Univ., Republic of Korea; Kwon, Wook H., Seoul National Univ., Republic of Korea; Kim, Yong H., Seoul National Univ., Republic of Korea; Song, Chanho, Agency for Defence Development, Republic of Korea; 1997, pp. 2769-2773; In English; Copyright; Avail: Aeroplus Dispatch

Receding horizon predictive control (RHPC) methodology is applied to the design of an autopilot for a bank-to-turn (BTT) missile. The main control objective is high tracking performance for guidance commands. The proposed RHPC-based autopilot consists of the RHPC and the design algorithm of future commands. The design algorithm of future commands determines future guidance commands required in the RHPC. It is based on the first-order approximation of the current guidance commands generated from the existing guidance law. The RHPC is designed for tracking control of pitch acceleration, yaw acceleration, and roll rate. It is shown by computer simulation that the RHPC-based autopilot offers good tracking performance in six-degree-of-freedom environments, which results in low terminal miss distances even for maneuvering targets.

Author (AIAA)

Automatic Pilots; Missile Control; Control Systems Design; Turning Flight

19980069296

A nonlinear constant bearing guidance and adaptive autopilot design for BTT missiles

Fu, Li-Chen, National Taiwan Univ., Taipei, Taiwan, Province of China; Chang, Wei-Der, National Taiwan Univ., Taipei; Chuang, Dun-Ming, National Taiwan Univ., Taipei; Kuo, Te-Son, National Taiwan Univ., Taipei; Wang, Tze-Chien, National Taiwan Univ., Taipei; Tsai, Chi-Wang, National Taiwan Univ., Taipei; 1997, pp. 2774-2778; In English

Contract(s)/Grant(s): NSC-84-2213-E002-061; Copyright; Avail: Aeroplus Dispatch

This paper is an integration of two earlier results on missile guidance and autopilot (Chuang, 1993; Chang, 1995). The guidance design is a nonlinear implementation of the constant bearing guidance. The guidance command in the form of acceleration is transformed into acceptable forms for the autopilot design. This design incorporates feedforward neural networks in the structure of adaptive control. Its weighting matrices and other unknown parameters are tuned on-line, and the approximation error of the neural networks is compensated via the technique of sliding mode control. The stability and performance of the integrated system are also investigated.

Author (AIAA)

Guidance (Motion); Missile Control; Adaptive Control; Automatic Pilots; Turning Flight; Control Systems Design

19980069361

Gain scheduling for lateral motion of propulsion controlled aircraft using neural networks

Jonckheere, Edmond A., Southern California, Univ., USA; Yu, Gwo-Ruye, Southern California, Univ., USA; Chien, Cheng-Chie, Southern California, Univ., USA; 1997, pp. 3321-3325; In English

Contract(s)/Grant(s): NSF ECS-95-10656; Copyright; Avail: Aeroplus Dispatch

A neural network approach to gain-scheduling linear dynamic controllers for the lateral motion of propulsion controlled aircraft (PCA) is introduced. The PCA system is adopted for emergency flight control of an airplane with multiple control surface failure in lateral motion. The linear controllers are synthesized at distinct flight conditions by the H-infinity methodology, which is applied to the problem of matching the dynamically compensated throttle-actuated crippled aircraft and the nominal control-surface-actuated aircraft model. The various H-infinity controllers at various flight conditions are used to train a radial basis network

which is then used as a gain scheduling controller. A simulation of the lateral control design of an L-1011 under emergency fly-by-throttle control demonstrates the concept.
Author (AIAA)
Neural Nets; Aircraft Control; Dynamic Control; H-Infinity Control

19980069444

Roll-yaw control at high angle of attack by forebody tangential blowing

Pedreiro, Nelson, EMBRAER, Brazil; Rock, Stephen M., Stanford Univ., USA; Celik, Zeki Z., Stanford Univ., USA; Roberts, Leonard, Stanford Univ., USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 69-77; In English
Contract(s)/Grant(s): F49620-96-1-0248; NCC2-55; Copyright; Avail: Aeroplus Dispatch

The feasibility of using forebody tangential blowing as the only actuator to control the roll-yaw motion of a wind-tunnel model at high angles of attack is demonstrated experimentally. to accomplish this, a unique model is developed that describes the unsteady aerodynamic moments generated by both vehicle motion and the applied blowing. This model is sufficiently detailed to predict the transient motion of the wiud-tunnel model, but is simple enough to be suitable for control design and implementation. Successful closed-loop control is demonstrated experimentally for a delta wing body model incorporating a 70-deg sweep angle and a cone-cylinder fuselage. Experiments were performed at 45-deg nominal angle of attack. At this condition, the natural motion of the system is divergent.
Author (AIAA)
Forebodies; Tangential Blowing; Aircraft Control; Yaw; Lateral Control; Roll; Wind Tunnel Models; Directional Control

19980069445

Motion analysis of two cable-connected bodies in atmospheric free-fall

Djerassi, Shlomo, Rafael Armament Development Authority, Israel; Viderman, Zvi, Rafael Armament Development Authority, Israel; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 78-83; In English
Report No.(s): AIAA Paper 97-3492; Copyright; Avail: Aeroplus Dispatch

Occasionally, missions of missiles are aborted shortly after launch. It is common practice in such events to activate self-destruct mechanisms that cause the explosion of the missiles and the dispersion of debris over large areas. This work presents an alternative approach to mission termination. Given a mission abortion signal, the missile is separated by means such as explosive bolts into two parts, connected to one another by a cable. A 1000-kg missile is considered, separated into a 200-kg, aerodynamically unstable part and an 800-kg, aerodynamically stable part. It is shown that if the altitude of the separation zone is 2000-10,000 m, the resulting motion causes the missile parts to hit the ground after traversing a horizontal distance, which essentially depends on the missile horizontal speed at the time of separation if the missile was in the subsonlc range, and that, within limits, this result depends weakly on the exact length of the cable and on the locations of the cable attachment points. Here the idea is presented together with an analysis supporting the indicated results and evaluating the impulses exerted during motion on the missile parts by means of the cable.
Author (AIAA)
Free Fall; Connectors; Abort Trajectories; Cables; Dynamic Response; Missile Trajectories

19980069447

Active control of helicopter blade stall

Nguyen, Khanh, NASA Ames Research Center, USA; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 91-98; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the numerical analysis of an automatic stall suppression system for helicopters. The analysis employs a finite element method and includes unsteady aerodynamic effects (dynamic stall) and a nonuniform inflow model. The stall suppression system, based on a transfer matrix approach, uses blade root actuation to suppress stall directly. The results show that stall can effectively be suppressed using higher harmonic blade root pitch at both cruise and high-speed flight conditions. The control amplitude was small, less than 1 deg. In a high-thrust, low-speed flight condition, stall is fairly insensitive to higher harmonic inputs. In general, stall suppression does not guarantee performance improvements. The results also show the distinction between stall suppression and performance improvement with active control. When the controller aims to reduce the shaft torque, rotor performance improvement can be achieved with a small degradation in stall behavior.
Author (AIAA)
Active Control; Aerodynamic Stalling; Helicopters; Numerical Analysis; Rotary Wings

19980069453

Active suppression of aircraft panel vibration with piezoceramic strain actuators

D'Cruz, Jonathan, DSTO, Australia; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 139-144; In English; Copyright; Avail: Aeroplus Dispatch

The out-of-plane vibration of a panel on an aircraft tailplane, excited by random noise in the 100-500 Hz range, was suppressed by an active controller that used four piezoceramic patches, two as strain actuators and two as strain sensors. The strain energy levels at these sensor locations were significantly reduced. Three accelerometers at arbitrarily chosen locations elsewhere on the panel demonstrated that the out-of-plane vibrational energy levels were also reduced there. The multi-input, multi-output digital controller, designed by a physically meaningful technique, also resulted in a system with good robustness properties.

Author (AIAA)

Strain Gages; Actuators; Structural Vibration; Vibration Damping; Active Control; Horizontal Tail Surfaces

19980069459

Minimum-state approximation - A pure lag approach

Balan, N., Indian Inst. of Technology, India; Mujumdar, P. M., Indian Inst. of Technology, India; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 161-163; In English; Copyright; Avail: Aeroplus Dispatch

Exact linear time-invariant finite-state representation of the equations of motion for a flexible aircraft is, in general, rendered impossible by the presence of transcendental functions that arise in the description of the unsteady airloads acting on the aircraft. However, strong motivation exists for a linear time-invariant finite-state representation because of the ease of solution of such systems as a consequence of the availability of efficient linear solvers. Rational function approximations (RFAs) to the unsteady airloads in the Laplace domain provide one method of allowing such a representation, albeit at the cost of an increased state vector dimension because of the appearance of additional states called aerodynamic lag states. These lag states are related to the basic system states through linear ordinary differential equations. The minimum-state approximation (Karpel, Journal of Aircraft, vol. 19, no. 3, 1982), termed the conventional minimum-state (CMS) approximation in this paper, appears to provide the best tradeoff, though at substantially increased computational costs, between the accuracy of the fit and the number of additional (lag) states in the state vector. This paper is concerned with an improved form of the minimum-state approximation. Panda (1995) and Suryanarayan et al. (AIAA Paper 93-1591, 1993) developed an extension of the RFA studied by Roger (1977), which allows for the separation of the unsteady aerodynamics into quasisteady terms and terms representative purely of the lag effects associated with the unsteady wake. This approximation was termed the pure lag approximation. The aim of this paper is to develop a pure lag minimum-state approximation and demonstrate its advantages compared with the CMS approximation.

AIAA

Aircraft Stability; Approximation; Unsteady Aerodynamics

19980069461

Neural network parameter extraction with application to flutter signals

Lee, B. H. K., National Research Council of Canada, Ottawa, Canada; Wong, Y. S., Alberta, Univ., Canada; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 165-168; In English; Copyright; Avail: Aeroplus Dispatch

Numerous methods have been proposed for real-time flutter identification of aircraft, with varying degrees of success. With the rapid advances in wavelet theory for signal processing and the use of artificial neural networks to model complex characteristics of nonlinear systems, more advanced methods to analyze flutter signals can be devised based on these modern developments. In this paper, a technique is outlined to determine frequencies and damping from a time series formed by a linear superposition of a number of exponentially decaying sine waves and corrupted by noise. The equation expressing this formulation is given here and is then rewritten after using the parameters given in Lee and Jones (1980). The rewritten equation is used to generate numerical data for a test case given in this paper. A wavelet transform package is formulated to separate the two-mode signal given in the rewritten equation, which results in two exponentially decaying sine waves. There are numerous techniques to solve for the frequency and damping of the two modes. A neural network is described that is designed for a single mode, as a multimode signal can always be decomposed into single-mode components using wavelets. The neural network developed here is based on supervised training and was successfully tested to extract frequency and damping parameters from a simulated exponentially decaying sine-wave signal. A particularly attractive feature of the approach is the ability to perform real-time parallel processing of multimode signals. The results suggest that the neural network can be used to analyze flutter signals.

AIAA

Neural Nets; Flutter; Signal Processing; Parameter Identification

19980070160

Development of operating limits, warning signals, and control algorithms for emergency situations using a safety criterion ***Formirovanie ehkspluatatsionnykh ogranichenij, signalov preduprezhdeniya i algoritmov upravleniya v osobykh situatsiyakh po kriteriyu bezopasnosti***

Soldatkin, V. M., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 85-92; In Russian; Copyright; Avail: Aeroplus Dispatch

The papers focuses on approaches to the development of information/control systems for ensuring flight safety in emergency situations associated with equipment failures, pilot errors, and hazardous external disturbances. Methods are presented for establishing operating limits, generating warning signals, and developing control algorithms in emergency situations using informative functions of flight safety.

AIAA

Automatic Flight Control; Flight Safety; Equations of Motion; Information Systems; Pilot Error; Flight Crews

19980071353

Relationship between stagnation point deflection and forebody vortex asymmetry

Darden, L. A., Georgia Inst. of Technology, Atlanta, USA; Komerath, N. M., Georgia Inst. of Technology, Atlanta; AIAA Journal; Dec. 1997; ISSN 0001-1452; Volume 35,, no. 12, pp. 1892-1894; In English

Contract(s)/Grant(s): F49620-93-1-0342; Copyright; Avail: Aeroplus Dispatch

The asymmetry in the vortex patterns in a cross flow plane near the wing-body juncture is related to the stagnation point displacement. Lateral vortex asymmetry at high angle of attack is shown to be controlled by deflecting the nose tip stagnation point, both statically and dynamically. The surface intersection of the zero vorticity contour is causally and linearly related to the movement of the nose-tip stagnation point. The time lag in vortex asymmetry response, as seem from flow images, occurs at approximately freestream convection speed.

AIAA

Stagnation Point; Vortices; Noses (Forebodies); Incidence; Body-Wing Configurations; Aircraft Control

19980071427

Airbus electrical flight control systems ***Les systemes de commandes de vol electriques des avions Airbus***

Briere, Dominique, Aerospatiale Aeronautique, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Apr. 1997; ISSN 1247-5793, no. 2, pp. 50-56; In French; Copyright; Avail: Aeroplus Dispatch

This article describes the Airbus' electrical flight control systems. Discussed are: (1) the basic principles upon which their concept is based, (2) the energy sources, (3) the cockpit controls, (4) the surface actuation, (5) the control laws, and (6) the mechanical backup. The advantages of this fly-by-wire control system are highlighted, namely, improved handling quality and safety, improved production cost, improved operating cost, and improved weight savings. The future evolutions are sketched, in particular, the partial suppression of hydraulics as a power source thanks to the increased use of electrical actuators, with the goal of obtaining new cost and weight savings and to increase the safety margin.

AIAA

European Airbus; Flight Control; Electric Control

19980071645

The use of inverse simulation for preliminary assessment of helicopter handling qualities

Thomson, D. G., Glasgow, Univ., UK; Bradley, R., Glasgow Caledonian Univ., UK; Aeronautical Journal; Sep. 1997; ISSN 0001-9240; Volume 101,, no. 1007, pp. 287-294; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a method for using inverse simulation to obtain a preliminary assessment of helicopter handling qualities. Formal descriptions of standard maneuvers, defined to establish the handling qualities of military helicopters, are used to drive an inverse simulation of a subject helicopter. The simulation generates the controls and states of the helicopter as it executes the maneuver, and the results may be used to calculate values of quickness, a parameter defined to measure responsiveness. Initial results reveal that in the context of inverse simulation, quickness is independent of vehicle configuration when, as specified in the requirements, the quickness is based on the helicopter's kinematic states. An alternative quickness parameter, associated with the control displacements required to fly the maneuver, is shown to be capable of discriminating between the pilot workload involved in flying two different configurations through the same maneuver.

Author (AIAA)

Helicopter Control; Control Simulation; Attitude Control; Control Systems Design

19980071992

Generalized predictive control for active flutter suppression

Haley, Pamela, NASA Langley Research Center, USA; Soloway, Don, NASA Ames Research Center, USA; IEEE Control Systems Magazine; Aug. 1997; ISSN 0272-1708; Volume 17, no. 4, pp. 64-70; In English; Copyright; Avail: Aeroplus Dispatch

This article presents experimental results of a transonic wind-tunnel test that demonstrates the use of generalized predictive control for flutter suppression for a subsonic wind-tunnel wing model. The generalized predictive control algorithm is based on the minimization of a suitable cost function over finite costing and control horizons. The cost function minimizes not only the sum of the mean square output of the plant predictions, but also the weighted square rate of change of the control input with its input constraints. An additional term was added to the cost function to compensate for dynamics of the wing model that cause it to be invariant to low input frequencies. This characteristic results in a control surface that drifts within the specified input constraints. The augmentation to the cost function that penalizes this low frequency drift is derived and demonstrated. The initial validation of the controller uses a linear plant predictor model for the computation of the control inputs. Simulation results of the closed-loop system that were used to determine nominal ranges for the tuning parameters are presented. The generalized predictive controller based on the linear predictor model successfully suppressed the flutter for all testable Mach numbers and dynamic pressures in the transonic region in both simulation and windtunnel testing.

Author (AIAA)

Vibration Damping; Active Control; Flutter Analysis; Transonic Wind Tunnels

19980072154

Affine nonlinear mathematical model for helicopter flight dynamics

Yang, Chao, Beijing Univ. of Aeronautics and Astronautics, China; Hong, Guanxin, Beijing Univ. of Aeronautics and Astronautics, China; Song, Shoufeng, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 471-476; In Chinese; Copyright; Avail: Aeroplus Dispatch

Preparing for further study of a nonlinear system and nonlinear control law for helicopters, a mathematical model of an affine nonlinear system for helicopter flight dynamics is established. In the process of choosing submodels and proposing assumptions, a principle for which all control variables in the differential equations must be linearized and the precision of model must be guaranteed simultaneously, should be used. The model is used to calculate the UH-60A helicopter in the conditions of trim in steady, level flight, as well as to obtain dynamic responses to different control inputs. The results agree with flight test and have considerable precision compared to the NASA-Ames GENHEL model. The math model is validated, and the theories and methods that have been used in the math model are all proven.

Author (AIAA)

Mathematical Models; Flight Mechanics; Helicopter Control; Nonlinear Systems

19980072160

Radar error analysis applied to air-to-air missile launch control parameters

Zhao, Hongliang, Beijing Univ. of Aeronautics and Astronautics, China; Mao, Shiyi, Beijing Univ. of Aeronautics and Astronautics, China; Li, Shaohong, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 512-516; In Chinese; Copyright; Avail: Aeroplus Dispatch

A model for computing air-to-air missile launch and control parameters is given based on the lead-pursuit attack mode. The computer simulation structure of missile delivery error analysis is established. The uncertainty effects on the missile launch and control parameters due to the airborne radar errors are studied, and computational results are obtained and discussed.

Author (AIAA)

Missile Control; Air to Air Missiles; Launching; Error Analysis; Radar Tracking

19980072305

Third X-36 test series to explore low-speed agility

Scott, William C., USA; Aviation Week & Space Technology; Oct. 27, 1997; ISSN 0005-2175; Volume 147, no. 17, pp. 88, 89; In English; Copyright; Avail: Aeroplus Dispatch

The third series of NASA/Boeing unmanned, tailless X-36 aircraft flight tests, aimed at evaluating agility at low speeds, are discussed. Attention is given to the head-up displays located at the NASA's Dryden Flight Research Center.

AIAA

Tailless Aircraft; Pilotless Aircraft; Research Aircraft; Flight Tests; Low Speed Stability; Maneuverability

19980072468

Combinative intelligence control of a helicopter flight control system with a weapon

Jiang, Changsheng, Nanjing Univ. of Aeronautics and Astronautics, China; Wang, Pihong, Nanjing Univ. of Aeronautics and Astronautics, China; Yang, Keming, Nanjing Univ. of Aeronautics and Astronautics, China; Qiu, Li, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Oct. 1997; ISSN 1005-2615; Volume 29, no. 5, pp. 494-499; In Chinese; Copyright; Avail: Aeroplus Dispatch

The discussion is devoted to an intelligence control method combining an expert system with artificial neural networks. This method was applied to the design of a helicopter flight control system. Based on the division of characteristic models of the system, the knowledge base, the data base, the rule base, and the inference mechanism of the expert system are designed meticulously. BP neural networks with three layers are then trained by the expert system controller. In the meantime, it is verified by a digital simulation for a helicopter that the expert system controller and the BP neural networks controller operate efficiently.

Author (AIAA)

Helicopter Control; Flight Control; Weapon Systems; Artificial Intelligence; Neural Nets

19980072584

A new model for high angle-of-attack motion of an aircraft

Shi, Zhongke, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 553-557; In Chinese; Copyright; Avail: Aeroplus Dispatch

For fighter aircraft, which should be easily maneuverable and highly resistant to departure/spin, a quaternion model is often used by many flight groups for processing recorded data. However, quaternions are without evident physical meaning and too difficult to measure. When using quaternions, both the quaternionic errors and the noise statistics are hard to determine. So we forsake the quaternion approach and present a new model. With the new model the dimensions of the state equation are decreased from 8 to 6, and all state variables are measurable. Both theoretical analysis and flight test of high angle-of-attack motions, such as spin, of aircraft show that significantly more accurate results can be obtained with the new model.

Author (AIAA)

Aircraft Models; Fighter Aircraft

19980072585

Variable structure control for aircraft in a windshear field

Zhou, Zhou, Northwestern Polytechnical Univ., China; Zhu, Xiaoping, Northwestern Polytechnical Univ., China; Liu, Qiangang, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 558-562; In Chinese; Copyright; Avail: Aeroplus Dispatch

This paper examines the application of variable structure control theory to the design of a flight path control system for an aircraft landing in an unknown windshear field. The objective in variable structure design is to confine the state trajectories to a subspace of the total state space. The motion in the subspace is insensitive to system parameter variations and external windshear disturbance that lie within the space limits of the control. A switching type of control law is naturally obtained during the design procedure. The design process consists of three parts. First, the windshear and the system perturbation are taken as uncertain factors, and the uncertain system model is presented. Then, the invariance conditions for an aircraft with respect to the windshear disturbance and the system parameter variations are derived. Finally, the sliding hypersurface of the variable structure control system and the flight path control laws are designed. The proposed control technique is feasible and efficient when applied to simulation calculations of the CITATION II aircraft penetrating a windshear field to land.

Author (AIAA)

Aircraft Control; Flight Control; Wind Shear

19980072754

Deformation of a flexible wing using an actuating system for a rolling maneuver without ailerons

Khot, N. S., USAF, Research Lab., USA; Appa, K., Northrop Grumman Corp., Military Aircraft Div., USA; Ausman, J., Northrop Grumman Corp., Military Aircraft Div., USA; Eastep, F. E., Dayton, Univ., USA; 1998, pp. 876-884; In English

Report No.(s): AIAA Paper 98-1802; Copyright; Avail: AIAA Dispatch

A technique of deforming a flexible wing to achieve a specified roll rate at all dynamic pressures is examined. Rather than using an aileron system for roll, antisymmetric elastic twist and camber is determined to achieve the required rolling moment for a specified roll rate. The elastic twist and camber is achieved by providing a system of actuating elements distributed within the internal substructure of the wing to provide control forces. The modal approach is used to develop equilibrium equations for the steady roll maneuver of a wing subjected to aerodynamic loads and actuating forces. The distribution of actuating forces to achieve

a specified flexible roll rate is determined by using an iterative procedure in conjunction with an optimal control design approach. A full-scale realistic wing is considered for the assessment of strain energy as a measure of the necessary power required to produce the antisymmetric twist and camber deformation to achieve the required roll performance. Subsonic and supersonic design conditions are investigated. Two sets of actuating control systems with a different number of actuators are considered.
Author (AIAA)
Elastic Deformation; Flexible Wings; Ailerons; Roll; Aeroelasticity; Bending Moments

19980072759

Investigating transient and limit cycle behaviors of a nonlinear structure by wavelet transforms

Lind, Rick, NASA, USA; Snyder, Kyle, NASA, USA; Brenner, Marty, NASA, USA; 1998, pp. 942-952; In English
Report No.(s): AIAA Paper 98-1808; Copyright; Avail: AIAA Dispatch

Nonlinear dynamics in aeroelastic systems are difficult to analyze and can induce dangerous limit cycle oscillations in flight. This paper introduces wavelet analysis for processing flight data responses to extract information about structural nonlinearities. Features and trends from wavelet transform maps of transient responses are used to detect and characterize a certain class of nonlinearities. These features are also used to formulate functions which may use transient responses at stable flight conditions to predict the onset of limit cycle oscillations.
Author (AIAA)
Aeroelasticity; Flight Envelopes; Nonlinear Systems; Fighter Aircraft

19980072913

Simulation of helicopter dynamic mechanical instability by MAPLE based nonlinear Lagrangian derivation

Robinson, C. S., U.S. Naval Postgraduate School, USA; Wood, E. R., U.S. Naval Postgraduate School, USA; King, R. L., U.S. Naval Postgraduate School, USA; 1998, pp. 2494-2506; In English
Report No.(s): AIAA Paper 98-2005; Copyright; Avail: AIAA Dispatch

This paper reports on a new method for formulating the full nonlinear equations of motion for ground/air resonance stability analyses of helicopter rotor systems. For validation the analysis is compared with Coleman's classic theory and is also applied to representative cases that include: the classic instability on isotropic supports; the case of one blade damper inoperative; and the case of one blade damaged by a ballistic strike.
Author (AIAA)
Computerized Simulation; Rotary Wings; Aircraft Stability; Ground Resonance; Nonlinear Equations

19980073002

Aeroelastic analysis of rolling maneuvers with multiple control surfaces in transonic flight

Andersen, G., USAF, Research Lab., USA; Kolonay, R., USAF, Research Lab., USA; Eastep, F., Dayton, Univ., USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1803; Copyright; Avail: AIAA Dispatch

This study investigates the use of multiple control surfaces to generate rolling maneuvers in the transonic flight regime. Linear and nonlinear aeroelastic analyses are performed to examine the effects of including flow nonlinearities in the prediction of roll performance generated through the utilization of leading and trailing edge control surfaces. Transonic small disturbance theory is employed in the analysis of a simple rectangular wing to study the interactions among control surface deflections, structural flexibility, and embedded shocks in the flow field. Pressure distributions on the wing are examined. Rolling moment calculations are presented as the Mach number is varied from a subsonic value through the transonic regime. These results are discussed based on the predictions of the pressure coefficients generated by the solution of the transonic small disturbance equation. Generalizations are then presented about the effects of including aerodynamic nonlinearities in the prediction of steady state roll rates caused by multiple control surface deflections in transonic flow conditions.
Author (AIAA)
Aircraft Maneuvers; Aeroelasticity; Rolling Moments; Control Surfaces; Transonic Flight; Flutter Analysis

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19980049528
UAV mission simulator
Carmeli, Alon, BVR Technologies, Ltd., Israel; 1997; In English; Copyright; Avail: Aeroplus Dispatch

UAVs were originally designed as systems which did not involve a human pilot and for a relatively low cost, but are today reaching the cost of a manned airplane, if not more. Along with technological developments and increasing demand for UAV missions in recent years, the operating skills required of the various crew members have become more complex and demanding. A few aspects of the UAV simulator market as viewed by Israeli Defense Force UAV system operators and by the BVR Technologies Ltd. (Israel) Simulators Manager are reviewed in this paper. BVR Technologies has developed a line of off-the-shelf simulation and training products, serving the worldwide community.
AIAA
Pilotless Aircraft; Military Vehicles; Remotely Piloted Vehicles; Reconnaissance Aircraft; Flight Simulators

19980051037
NH-96 flight simulation system for pilotless aircraft
Yu, Deyi, Nanjing Univ. of Aeronautics and Astronautics, China; Wan, Xiaodong, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics and Astronautics, Journal; Feb. 1998; ISSN 1005-2615; Volume 30, no. 1, pp. 117-120; In Chinese; Copyright; Avail: Aeroplus Dispatch

Some particular demands of the hardware-in-the-loop simulation system are discussed. The components and the performance of the recently developed NH-96 flight simulation system are presented. Finally, as an example, the hardware-in-the-loop simulation of a flight control system for pilotless aircraft is presented.
Author (AIAA)
Flight Simulation; Pilotless Aircraft; Flight Control

19980051652
Anechoic wind tunnels
Brouwer, H. H., NLR, Netherlands; 1997; In English; Copyright; Avail: Aeroplus Dispatch

An overview of the most important aspects of acoustically treated wind tunnels and aeroacoustic testing in such tunnels is presented. Wind tunnel requirements and design in terms of background noise and anechoic environment are discussed. Characteristics of such anechoic wind tunnels as the German-Dutch Wind Tunnel DNW, the CEPRA 19, the ARA Transonic Wind Tunnel, the S1MA Wind Tunnel, and the NASA Ames 40x80 Foot Subsonic Wind Tunnel are presented. Applications to propeller noise, helicopter noise, and airframe noise are also examined.
AIAA
Aeroacoustics; Active Control; Noise Reduction; Anechoic Chambers; Transonic Wind Tunnels; Subsonic Wind Tunnels

19980052608 Transportation Research Board, Washington, DC USA
Airports Ground Access and Economic Issues
Sep. 1997; 52p; In English
Report No.(s): PB98-117773; TRB/TRR-1600; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Topics considered include: Increasing Rail Transit Access to Airports in Chicago; Airport Ground Access and Intermodal Interface; Origin-Specific Visitor Demand Forecasting at Honolulu International Airport; General Aviation User Benefits.
NTIS
Airports; Economic Factors

19980052816
Hong Kong's new airport is a model of integration
Chaplin, Richard, Control Systems Int. (CSI); Dodson, Terry; Adams, Thomas G. , Jr.; InTech; Nov, 1997; ISSN 0192-303X; Volume 44, no. 11, pp. 32-35; In English; Copyright; Avail: Issuing Activity

Building management and supervisory control and data acquisition system will contribute to the smooth operation of Hong Kong's new airport upon its opening in the spring of 1998. The extensively distributed systems, with more than 25,000 input/out-

put (I/O) points and 500 remote I/O locations, are designed to conform with open system standards and the Airport Authority master systems integration plan. The integrated system are designed not only to meet the airport a first-phase capacity of 35 million passengers a year on opening day, but also to serve its needs for the next 50 years of planned expansion.
EI
Hong Kong; Systems Integration; Airports; Project Management; Data Acquisition; Systems Analysis

19980055367

Flow characterization in the ONERA F4 high-enthalpy wind tunnel

Sagnier, Philippe, ONERA, France; Verant, Jean-Luc, ONERA, France; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 522-531; In English
Report No.(s): AIAA Paper 96-2239; Copyright; Avail: Aeroplus Dispatch

Experimental results obtained in the ONERA F4 hot-shot wind tunnel have been analyzed to address two important problems for this type of wind tunnel, i.e., the determination of reservoir conditions and the thermochemical nature of the nozzle flow. Numerical tools (one-dimensional and two-dimensional inviscid or viscous, unsteady or space marching codes) are used to reproduce the results of the high-enthalpy experiments. to illustrate this approach, several runs are investigated with different arc-chamber material options, for which diode laser infrared absorption spectrometry (DLAS) has provided freestream velocity, translational temperature, and nitric oxide concentration measurements. The reservoir enthalpy can be determined using spherical and sharp-cone probe heat-transfer-rate measurements with adequate correlations. Recent direct measurements of freestream velocity with electron beam fluorescence time-of-flight technique are used to cross check DLAS and heat-transfer-rate probe results. Concerning the thermochemical nature of F4 nozzle flows, an unexpected conclusion is obtained, as the nozzle wall pressure and translational temperature are observed to be close to equilibrium values at high-enthalpy operating conditions. A thermochemical model is proposed, involving vibration-dissociation-recombination coupling, which seems able to reproduce available experimental data.
Author (AIAA)
Flow Characteristics; Wind Tunnel Tests; Nozzle Flow; Aerodynamic Heat Transfer

19980055398

A new screen for turbulence attenuation at higher Reynold numbers

McKeage, Bradley J., Tennessee, Univ., Tullahoma, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0011; Copyright; Avail: Aeroplus Dispatch

To meet flow uniformity and low turbulence requirements in the test section in high Reynolds number facilities, a new type of wire mesh screen is designed which allows turbulence management at higher Reynolds numbers. The new design, even though more complex to manufacture, is inherently more effective in reducing flow nonuniformities and downstream turbulence level. This paper presents preliminary experimental results on the flow field downstream of this new wire screen. Limited measurements at Re = 75 and 600 indicate a broader frequency content in the flow downstream of the modified screen. Turbulence intensity, however, is only slightly lower than the unmodified screen.
Author (AIAA)
Turbulence; Attenuation; High Reynolds Number; Unsteady Flow

19980055417

Development of the Cox Icing Research Facility

Al-Khalil, Kamel, Cox & Co., Inc., New York, USA; Salamon, Laszlo, Cox & Co., Inc., New York; Tenison, Gary, Tenison Engineering, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0097; Copyright; Avail: Aeroplus Dispatch

The LeClerc Icing Research Laboratory was designed and constructed at Cox & Company in downtown New York City. The facility was engineered to meet a number of design criteria in addition to being environmentally nonintrusive to the surroundings. It consists of a closed-loop refrigerated wind tunnel with the capability to simulate a cloud of supercooled water droplets as specified in the FAR's Part 25-C. Two test sections are provided with an airspeed up to 220 mph in the main test section and 120 mph in the secondary one. Provision for testing engine inlet nacelles is provided with a scavenge system that is capable of simulating engine core air flows of up to 15 lb/sec. The tunnel air temperature can be controlled down to -22 F at the maximum heat load conditions.
Author (AIAA)
Aircraft Icing; Nonintrusive Measurement; Feedback Circuits; Wind Tunnel Tests; Aircraft Engines; Engine Tests

19980055449

Sustainment program for the 16-ft tunnels in the propulsion wind tunnel facility at the Arnold Engineering Development Center

Stich, Philip, Sverdrup Technology, Inc., USA; Rose, Dennis, Sverdrup Technology, Inc., USA; Smoliga, Nick, Sverdrup Technology, Inc., USA; Sipe, Kevin, Sverdrup Technology, Inc., USA; Mills, Michael, Sverdrup Technology, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0140; Copyright; Avail: Aeroplus Dispatch

The age and condition of wind tunnel facilities in the U.S. necessitates significant sustainment efforts to maintain reliable and efficient testing capability into the next decade. Many national facilities located at the major NASA centers and the DOD's Arnold Engineering Development Center (AEDC) are in the middle of or preparing for major refurbishment programs. In Fiscal Year 1998, the Propulsion Wind Tunnel (PWT) Facility at AEDC launched a 7-year, $80 million sustainment program to improve reliability, reduce testing cycle time, and reduce the number of operational stationkeepers, and improve the quality of test data in the 16-ft Transonic and Supersonic Wind Tunnels. The program has four major elements: (1) replace the data acquisition and processing systems in both Tunnels 16T and 16S; (2) replace the starting motor system for the 16T/S Main Drive System; (3) provide a second atmospheric air dryer for the PWT facility; and (4) improve the flow quality of Tunnel 16S.

Author (AIAA)

Wind Tunnels; USA; Upgrading

19980055450

Wind tunnel test productivity and technology accomplishments at Ames in the ADTE program

Muhlstein, Lado, Jr., NASA Ames Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0141; Copyright; Avail: Aeroplus Dispatch

Productivity improvements demonstrated and/or implemented in the Ames 12-Foot Pressure Wind Tunnel (12-ft PWT) for the Aeronautics Design and Test Environment program are presented. The improvements were focused in three primary areas: (1) data system productivity and accuracy improvements, (2) optimization of tunnel controls, pressure controls, and blowdown, and (3) quick model change hardware and instrumentation. Productivity improvement is demonstrated using the baseline test technique. The baseline test used is representative of a bipod mounted high-lift model tested in the 12-ft PWT prior to restoration of the tunnel. Productivity improvement of over 115 percent is achieved compared to productivity prior to this series of modifications; this represents productivity of over 7.5 times that achieved in the 12-ft PWT prior to restoration. Numerous other improvements are presented including many which will further improve productivity when fully implemented and can be quantified when incorporated into a more current measurement model. Some items which improve productivity of semispan testing are also presented.

Author (AIAA)

Wind Tunnel Tests; Productivity; Upgrading

19980055451

Accelerating ground-test cycle time - The six-minute model change and other visions for the 21st century

Kegelman, Jerome T., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0142; Copyright; Avail: Aeroplus Dispatch

The advantage of managing organizations to minimize product development cycle time has been well established. This paper provides an overview of the wind tunnel testing cycle time reduction activities at NASA-Langley, and gives the status of several improvements in the wind tunnel productivity and cost reductions that have resulted from these activities. Processes have been examined and optimized. Metric data from monitoring processes provides guidance for investments in advanced technologies. The most promising technologies under implementation today include the use of formally designed experiments, a diverse array of quick-disconnect technology and the judicious use of advanced electronic and information technologies.

Author (AIAA)

Ground Tests; Wind Tunnel Tests; Multidisciplinary Design Optimization

19980055452

The new icing cloud simulation system at NASA Lewis' icing research tunnel

Irvine, Thomas B., NASA Lewis Research Center, USA; Oldenburg, John R., NASA Lewis Research Center, USA; Sheldon, David W., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0143; Copyright; Avail: Aeroplus Dispatch

A new spray bar system has been designed, fabricated, and installed in the NASA Lewis Research Center's Icing Research Tunnel (IRT). This system is key to the IRT's ability to do aircraft in-flight icing cloud simulation. The performance goals and requirements levied on the design of the new spray bar system included increased size of the uniform icing cloud in the IRT test section, faster system response time, and increased coverage of applicable FAR Part 25 and 29 Appendix C in-flight icing regulations. Through significant changes to the mechanical and electrical designs from the previous generation spray bar system, the performance goals and requirements were realized. Postinstallation aerodynamic and icing cloud calibrations were performed in order to quantify the changes and improvements to the IRT test section flow quality and icing cloud characteristics. The new and improved capability at the IRT to simulate aircraft encounters with in-flight icing clouds ensures that the IRT will continue to provide a satisfactory icing ground test simulation method to the aeronautics community.
Author (AIAA)
Aircraft Icing; Wind Tunnels; Wind Tunnel Apparatus; Cloud Glaciation; Simulation

19980055453
The design of the Korea Air Force Academy subsonic wind tunnel
Kang, Chi-Hang, Korea Air Force Academy, Republic of Korea; Baek, Seung-Woock, Korea Air Force Academy, Republic of Korea; Chang, Jo-Won, Korea Air Force Academy, Republic of Korea; Chaney, Michael J., Sverdrup Technology, Inc., USA; Hamby, Michael A., Sverdrup Technology, Inc., USA; Lutz, Ronald G., Aerotech ATE, Ltd., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0144; Copyright; Avail: Aeroplus Dispatch

A multipurpose subsonic wind tunnel facility has been designed for the Korea Air Force Academy in South Korea, and construction of this facility is nearing completion. This wind tunnel will be used in development of aircraft and ground vehicles as well as for basic studies in aeronautical engineering. The facility includes the wind tunnel and a building complex with offices, workshops, and test test hall. The main test section dimensions are 2.45 m high, 3.5 m wide and 8.7 m long. Velocity ranges from 5 to 92 m/sec, with a fan power of 2,000 kW. High flow quality is achieved, with turbulence intensity designed to be below 0.05 percent-rms. Flow angularity is designed to be less than +/- 0.1 deg. The wind tunnel has interchangeable test sections, several model support systems, a variety of instrumentation systems, and a probe traverse system. The external balance can be elevated to provide high accuracy for the various model types and to accommodate model/test section exchanges. The test facility systems and the building are integrated to provide excellent model handling and testing productivity.
Author (AIAA)
Armed Forces (Foreign); Korea; Subsonic Wind Tunnels; Wind Tunnel Apparatus

19980055454
From the 30 by 60 to the Langley Full Scale Tunnel
Britcher, Colin P., Old Dominion Univ., USA; Landman, Drew, Old Dominion Univ., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0145; Copyright; Avail: Aeroplus Dispatch

Old Dominion University (ODU) has negotiated a long-term operating agreement with NASA-Langley permitting ODU to reopen the Full Scale wind tunnel as an independent, self-financing operation. This tunnel, formerly known as the NACA/NASA Full Scale Tunnel and later as the NASA '30 by 60', is the second largest in the U.S. in terms of test section size, and is now the largest university-operated facility in the world. We review the history of this unique facility's 64 years of service. Next, the motivations for the reopening and the potential applications of a facility of this type are addressed; these applications include aerospace and ground vehicle testing, with full-scale automotive testing seen as the strongest near-term opportunity. The management and operating approach for the facility involves a unique partnership between federal and state government, military services, academia, a not-for-profit foundation and private industry. The proposed arrangement and problems arising are briefly addressed. Finally, the educational and training thrust, seen as an integral part of the tunnel's operation, is reviewed.
Author (AIAA)
Wind Tunnels; Technology Utilization

19980055456
Langley Aerothermodynamic Facilities Complex - Enhancements and testing capabilities
Micol, John R., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0147; Copyright; Avail: Aeroplus Dispatch

Description, capabilities, recent upgrades, and utilization of the NASA-Langley Aerothermodynamic Facilities Complex (AFC) are presented. The AFC consists of five hypersonic, blow-down-to-vacuum wind tunnels that collectively provide a range of Mach number from 6 to 20, unit Reynolds number from 0.04 to 22 million/ft and, most importantly for blunt configurations, normal shock density ratio from 4 to 12. These wide ranges of hypersonic simulation parameters are due, in part, to the use of three

different test gases (air, helium, and tetrafluoromethane), thereby making several of the facilities unique. The AFC represents nearly three-fourths of the conventional (as opposed to impulse) type hypersonic wind tunnels operational in this country. AFC facilities are used to assess and optimize the hypersonic aerodynamic performance and aeroheating characteristics of aerospace vehicle concepts and to provide benchmark aerodynamic/aeroheating data for generating the flight aerodynamic databook and final design of the thermal protection system. Modifications and enhancements of AFC hardware components and instrumentation have been pursued to increase capability, reliability, and productivity in support of programmatic goals.
Author (AIAA)
Aerothermodynamics; Test Facilities; Upgrading

19980055458

Early ballistic diagnostics of a simulator with a two-increment change

Chang, Lang-Mann, U.S. Army, Research Lab., USA; Hui, Philip Y., U.S. Army, Research, Development, and Engineering Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0149; Copyright; Avail: Aeroplus Dispatch

Experimental studies using a full-scale ballistic simulator have been conducted as an investigation into the origin of large-amplitude pressure waves observed in firing a two-increment charge in a 165 mm ballistic launcher. The studies focus on ignition events including flame-spreading, movement of charge increments, pressure rises at the ends of the combustion chamber of the launcher, and their correlations. Results show that a charge movement occurred following the flame spread which is initiated by the ignition of the charge igniters. In addition, there was an increasing separation between the two increments during the ignition process. After traveling a certain distance, the rear increment gradually slowed down or even reversed its direction while the forward increment continued to accelerate forward. by the instant that the simulator chamber ruptured, occurring at approximately 14 MPa, the forward increment had gained a speed in excess of 70 m/s and reached a position only 120 mm behind the projectile base. In actual ballistic firings, a high concentration of burning propellant grains is thus expected to form near, if not at, the projectile base prior to movement of the projectile. This can lead to a localized pressure rise at the forward end of the chamber, and can eventually induce pressure waves traveling back and forth between the chamber ends.
Author (AIAA)
Ballistics; Elastic Waves; Simulators; Firing (Igniting)

19980055492

Quantification of ice accretions for icing scaling evaluations

Ruff, Gary A., Drexel Univ., USA; Anderson, David N., Streatham Hill Research, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG3-2043
Report No.(s): AIAA Paper 98-0195; Copyright; Avail: Aeroplus Dispatch

The comparison of ice accretion characteristics is an integral part of aircraft icing research. It is often necessary to compare an ice accretion obtained from a flight test or numerical simulation to one produced in an icing wind tunnel or for validation of an icing scaling method. Traditionally, this has been accomplished by overlaying 2D tracings of ice accretion shapes. This paper addresses the basic question of how to compare ice accretions using more quantitative methods. For simplicity, geometric characteristics of the ice accretions are used for the comparison. One method evaluated is a direct comparison of the percent differences of the geometric measurements. The second method inputs these measurements into a fuzzy inference system to obtain a single measure of the accuracy of the comparison. The procedures are demonstrated by comparing ice shapes obtained in the Icing Research Tunnel at NASA/Lewis during recent icing scaling tests. The results demonstrate that this type of analysis is useful in quantifying the similarity of ice accretion shapes, and that the procedures should be further developed by expanding the analysis to additional icing data sets.
Author (AIAA)
Aircraft Icing; Deposition; Research and Development

19980055493

Evidence for importance of scaling viscous effects in the water film in glaze icing tests

Kind, R. J., Carleton Univ., Canada; Dillon, T., Carleton Univ., Canada; Gaydos, J. A., Carleton Univ., Canada; Oleskiw, M., National Research Council of Canada, Ottawa; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0196; Copyright; Avail: Aeroplus Dispatch

In glaze icing some liquid water is present on the surface of the ice accretion; this paper reports on icing-tunnel experiments which explored the influence of surface tension and viscosity of this water on icing behavior and scaling laws. Icing tests were done with 45- and 20-mm-diameter cylinders, the 'reference' case and the 'subscale' case, respectively. The reference and some

subscale runs were done using pure demineralized spray water; other sub-scale runs were done with water-propanol solutions. In the latter runs, 1-propanol was added to the spray water in concentrations of either 1 or 5 percent in order to reduce the surface tension of the water. In some of the sub-scale runs the Weber number based on cylinder diameter was matched to the reference value while in other runs a parameter involving water viscosity was matched instead. All other accepted similarity parameters were matched in all cases. The results indicate that water viscosity is important and that the relevant Weber number is the one based on thickness of the water film or rivulets present on the ice surface. Both of these are new hypotheses. If these hypotheses are correct, the relevant Weber number would 'automatically' be matched if the water-viscosity parameter and other similarity parameters are matched, and there would be no incentive to manipulate the surface tension of the spray water.
Author (AIAA)
Ice; Deposition; Interfacial Tension; Viscosity; Scaling Laws

19980055499

Impulse measurement technology development at the Arnold Engineering Development Center (AEDC)

Marquart, E. J., Sverdrup Technology, Inc., USA; Coulter, S. M., Sverdrup Technology, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0203; Copyright; Avail: Aeroplus Dispatch

This paper discusses the development at AEDC of a measurement technique to be used in continuous-flow wind tunnels to measure approximately 5-50-millisec-duration impulse loads on test articles. Accelerometers are used in conjunction with a cross-flexure balance to obtain force and moment measurements of impulse loads as short as approximately 5/1000-s duration. A math model of the mechanism is developed and used to show that the measurement concept is a valid scheme. Results from a laboratory demonstration of a two-component measurement system also indicate excellent agreement between impressed impulse loads and the measurements from the mechanism.
Author (AIAA)
Impulses; Wind Tunnel Tests; Mathematical Models

19980055528

Revolutionary technologies for miniature measurement systems - Application to ground testing

D'Amico, William P., Jr., U.S. Army, Research Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0234; Copyright; Avail: Aeroplus Dispatch

A survey of telemetry techniques for miniature and high-g applications is provided. The sum of many individual efforts is providing an expanding set of tools and techniques by which a new generation of flight tests is possible. Additionally, major thrusts have been made to substantially reduce the cost of key components and modules of the telemetry system. Given new capabilities in transmitters, power supplies, electronic packaging, and sensors, it is important to review the synergism between flight and ground test methodologies.
Author (AIAA)
Ground Tests; Telemetry; High Acceleration; Miniaturization; Research and Development

19980055621

A sheet laser flow visualization system in the NASA Lewis Icing Research Tunnel

Canacci, Victor A., NYMA, Inc., USA; Bencic, Timothy J., NASA Lewis Research Center, USA; Krupar, Martin J., NASA Lewis Research Center, USA; Potapczuk, Mark G., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0342; Copyright; Avail: Aeroplus Dispatch

A sheet laser flow visualization system at the Icing Research Tunnel (IRT) at NASA/Lewis has provided an additional diagnostic and analysis capability to the facility. This system allows visualization of flow-field characteristics of test articles, such as stationary vortices and separation regions, and how such flow structures are impacted by the growth of ice on the test article. Additionally, the system can be used to evaluate icing cloud uniformity conditions and to identify the location in the test section of water droplets emitted from individual spray nozzles. This system has been used successfully to determine the locations of vortices, separation regions, and nozzle sprays in the test section. The system is comprised of an argon-ion laser coupled to commercially available sheet generating optics. These sheets can be projected either vertically or horizontally throughout the test section. The IRT's unique spray bars are used to seed the flow with either super-cooled water droplets or ice spheres, depending upon tunnel and spray bar conditions, to seed the airflow.
Author (AIAA)
Flow Visualization; Wind Tunnels; Aircraft Icing; Wind Tunnel Apparatus; Laser Applications

19980055622

Open architecture dynamic data system at Langley's Transonic Dynamics Tunnel

Bryant, Charles S., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0343; Copyright; Avail: Aeroplus Dispatch

In the early 1990s, the Data System and Instrument Support Branch at NASA/Langley started developing a new generation of data acquisition systems (DAS). The new system, called the open architecture (OA) data acquisition system, was based on the UNIX operating system and standard hardware interfaces: VME, IEEE-488, and SCSI. The open architecture dynamic data system for the Transonic Dynamics Tunnel (TDT-DAS) was installed in a shakedown capacity in January 1996 in parallel with the existing proprietary data system. The new system was permanently installed in early 1997 and was used to support instrument and tunnel calibration in mid to late 1997. The Transonic Dynamics Tunnel is scheduled to resume testing in February 1998 with the TDT-DAS as its primary system. This paper describes the key hardware and software aspects of this system.

Author (AIAA)

Transonic Wind Tunnels; Data Systems; Data Acquisition; Architecture (Computers)

19980055624

Open architecture data system for NASA Langley Combined Loads Test System

Lightfoot, Michael C., NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0345; Copyright; Avail: Aeroplus Dispatch

The Combined Loads Test System (COLTS) is a new structures test complex that is being developed at NASA/Langley to test large curved panels and cylindrical shell structures. These structural components are representative of aircraft fuselage sections of subsonic and supersonic transport aircraft and cryogenic tank structures of reusable launch vehicles. Test structures are subjected to combined loading conditions that simulate realistic flight load conditions. The facility consists of two pressure-box test machines and one combined loads test machine. Each test machine possesses a unique set of requirements for research data acquisition and real-time data display. Given the complex nature of the mechanical and thermal loads to be applied to the various research test articles, each data system has been designed with connectivity attributes that support both data acquisition and data management functions. This paper addresses the research driven data acquisition requirements for each test machine and demonstrates how an open architecture data system design not only meets those needs but provides robust data sharing between data systems, including the various control systems which apply spectra of mechanical and thermal loading profiles.

Author (AIAA)

Data Systems; Architecture (Computers); Cylindrical Shells; Curved Panels; Fuselages; Storage Tanks

19980055627

Improving wind tunnel test processes with modern data systems

Reynolds, Chuck, Hewlett-Packard Co., USA; Hamilton, Steve, Hewlett-Packard Co., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0348; Copyright; Avail: Aeroplus Dispatch

The development of modern aeronautical structures has been advanced significantly over the last few years by better testing of aircraft models. A key requirement for future improvements will be more accurate measurements of the model under continuous pitch operation rather than using only the traditional pitch-pause technique. A side benefit of using continuous pitch will be increased wind tunnel utilization and faster design cycles. As percentage gains in aerodynamic performance become incrementally smaller, more accurate measurements of these parameters will become critical. In addition, the controlling functions for the model position and even the tunnel fluid flow must also become more precise. This paper illustrates these points with examples of aerodynamic development challenges accompanied by descriptions of the key data system and control requirements, such as sampling speed, measurement accuracy, triggering flexibility, and control algorithm flexibility.

Author (AIAA)

Wind Tunnel Tests; Data Systems; Upgrading

19980055730

Measurement and correlation of ice accretion roughness

Anderson, David N., Streatham Hill Research, USA; Hentschel, Daniel B., Rochester Inst. of Technology, USA; Ruff, Gary A., Drexel Univ., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAG3-2043

Report No.(s): AIAA Paper 98-0486; Copyright; Avail: Aeroplus Dispatch

Measurements were taken of the roughness characteristics of ice accreted on NACA 0012 airfoils in the NASA/Lewis Icing Research Tunnel (IRT). Tests were conducted with size scaled, using models with chords of 26.7, 53.3, and 80.0 cm, and with liquid-water content scaled, both according to previously-tested scaling methods. The width of the smooth zone which forms on either side of the leading edge of the airfoil and the diameter of the roughness elements are presented in non-dimensional form as functions of the accumulation parameter. The smooth-zone width was found to decrease with increasing accumulation parameter. The roughness-element diameter increased with accumulation parameter until a plateau was reached. This maximum diameter was about 0.06 times twice the model leading-edge radius. Neither smooth-zone width nor element diameter were affected by a change in freezing fraction from 0.2 to 0.4. Both roughness characteristics appeared to scale with model size and with liquid-water content.
Author (AIAA)
Aircraft Icing; Surface Roughness; Wind Tunnel Tests; Airfoils

19980055788

Hypersonic gaseous piston shock tunnel - Numerical and experimental results

do Nascimento, M. A. C., Lab. of Aerothermodynamics and Hypersonics, Brazil; Municci, M. A. S., Lab. of Aerothermodynamics and Hypersonics, Brazil; Ramos, A. G., Lab. of Aerothermodynamics and Hypersonics, Brazil; Chanes, J. B., Jr., Lab. of Aerothermodynamics and Hypersonics, Brazil; Nagamatsu, H. T., Rensselaer Polytechnic Inst., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0548; Copyright; Avail: Aeroplus Dispatch

Recent experimental results have indicated that by inserting a thin section, previously filled with some kind of gas, in between the driver and driven sections of a shock tube/tunnel improves its performance. This technique has been able to produce higher reservoir enthalpy levels then usually obtained with a conventional shock tube/tunnel when operating in the equilibrium interface condition. This new technique, tentatively called the Gaseous Piston Technique, also has been proven to increase the available test time by acting as a separating gas and, therefore, reducing the test gas contamination by the driver gas. An additional benefit of this reduced contamination is preventing combustion from taking place at the air-hydrogen interface, when hydrogen is used as the driver gas and air as the test gas. The present numerical and experimental investigation examines the influence of the separating gas nature and its initial fill pressure on the final equilibrium interface reservoir conditions. Results indicate that gases exhibiting a high molecular/atomic weight and a high value of the ratio of specific heats at high initial fill pressures perform the best.
Author (AIAA)
Shock Tunnels; Piston Engines; Fuel-Air Ratio; Hypersonic Wind Tunnels; Wind Tunnel Drives

19980055790

Recent advances in detonation techniques for high-enthalpy facilities

Lu, Frank K., Texas, Univ., Arlington, USA; Wilson, Donald R., Texas, Univ., Arlington; Stuessy, W. S., Texas, Univ., Arlington; Bakos, Robert J., GASL, USA; Erdos, John I., GASL, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0550; Copyright; Avail: Aeroplus Dispatch

Detonations can be used to generate a high-pressure gas of high acoustic speed to drive a shock tube. Recently, detonation-driven facilities have been implemented for meaningful hypervelocity testing. These facilities can be operated with the detonation wave propagating downstream or upstream. The advantages and problems associated with these methods are discussed. In addition to a performance comparison between these two modes, comparisons with other high-performance techniques, such as free-piston and gun tunnels, is also made. At present, detonation-driven facilities are generally of lower performance than free-piston tunnels. However, they appear easier to operate.
Author (AIAA)
Detonation Waves; Gas Pressure; Shock Tubes; Wind Tunnel Drives; Hypersonic Wind Tunnels

19980055791

A review of test medium contamination effects on test article combustion processes

Powell, Stan E., Sverdrup Technology, Inc., USA; Stallings, D. W., Sverdrup Technology, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0551; Copyright; Avail: Aeroplus Dispatch

One of the concerns with ground testing is that the thermochemical characteristics of the flight medium, the standard test medium, are different from the thermochemical characteristic of the ground test medium, a nonstandard test medium, (NSTM). This paper is concerned with the effects on hypersonic air-breathing propulsion systems that may be a result of the method used to supply the energy necessary for simulation of hypersonic flight in the atmosphere. A review was begun of published results that address the effects of an NSTM on combustion in the test article. This paper documents the current understanding of the effects of available energy addition processes on the test medium and suggests an approach to make the best possible use of ground test

facilities. All energy addition methods currently used to simulate hypersonic atmospheric flight create an NSTM. The best solution to the problem of NSTM effects is to be aware of the differences between the flight medium and the NSTM and to know how these differences affect the test results.
Author (AIAA)
Fuel Combustion; Ground Tests; Arc Heating; Exhaust Emission; Nitric Oxide; Environment Pollution

19980055793
Hyper-X Wind Tunnel Program
McClinton, C. R., NASA Langley Research Center, USA; Holland, S. D., NASA Langley Research Center, USA; Rock, K. E., NASA Langley Research Center, USA; Engelund, W. C., NASA Langley Research Center, USA; Voland, R. T., NASA Langley Research Center, USA; Huebner, L. D., NASA Langley Research Center, USA; Rogers, R. C., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0553; Copyright; Avail: Aeroplus Dispatch

This paper provides an overview of NASA's focused hypersonic technology program, called the Hyper-X Program. It is designed to move hypersonic, air breathing vehicle technology from the laboratory environment to the flight environment, the last stage preceding prototype development. The Hyper-X research vehicle will provide the first-ever opportunity to obtain data on an airframe-integrated scramjet (supersonic combustion ramjet) propulsion system at true flight conditions and the first opportunity for flight validation of experimental wind tunnel, numerical, and analytical methods used for design of these vehicles. A substantial portion of the program is experimentally based, both for data-base development and performance validation. The program is now concentrating on Mach 7 vehicle development, verification, and validation and flight test risk reduction. This paper concentrates on the aerodynamic and propulsion experimental programs. Wind tunnel testing of the flight engine and complete airframe integrated scramjet configuration flowpath is expected in 1998 and 1999, respectively, and flight test is planned for 2000.
Author (AIAA)
Hypersonic Wind Tunnels; NASA Programs; Air Breathing Engines; Research Vehicles; Supersonic Combustion Ramjet Engines; Wind Tunnel Tests

19980055825
Measurements of vortices stalled near extended runway centerline on final approach
Hallock, J. N., DOT, Volpe National Transportation Systems Center, USA; Sigona, J. J., DOT, Volpe National Transportation Systems Center, USA; Burnham, D. C., Scientific and Engineering Solutions, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0591; Copyright; Avail: Aeroplus Dispatch

Longitudinal separation standards for final approach must account for the possibility that a wake vortex generated by the preceding aircraft may, because of interaction with the ground and the ambient crosswind, remain stalled in the glide path. A ground-based array of anemometers was used extensively in the 1970s to detect such stalled vortices. Recent developments in the capabilities of such arrays have permitted completely automatic operation and estimates of vortex height and circulation. The array also gives measurements of the ambient wind close to the location where the vortex lateral motion is measured. Data collected over ten months in 1994-95 at Kennedy Airport are analyzed and compared to the 1970s results and to a mathematical model for the probability of encountering a wake vortex in the absence of vortex decay. The analysis concentrates on the arrivals when atmospheric turbulence was low (1) to optimize the vortex detection sensitivity of the array and (2) to select conditions where long vortex lifetimes can be expected.
Author (AIAA)
Vortices; Runways; Aerodynamic Stalling; Flow Measurement; Ground Effect (Aerodynamics); Approach

19980055827
Measurements of wake vortices interacting with the ground
Burnham, D. C., Scientific and Engineering Solutions, Inc., USA; Hallock, J. N., DOT, Volpe National Transportation Systems Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0593; Copyright; Avail: Aeroplus Dispatch

Although wake vortices are known to decay more rapidly near the ground than away from the ground, the details of the ground interaction are not well understood. Propeller anemometer arrays located under the approach path have been used to study vortex transport and provide some information about the vortex interaction with the ground, such as the generation of secondary vortices via boundary layer detachment. A propeller anemometer array at Kennedy Airport using 8.5-m poles was augmented with (1) a sonic anemometer measuring 3D wind and temperature at 10 Hz and (2) a vertical array of vertical wind and crosswind anemometers, mounted at four additional levels (4.2, 3.2, 1.05, and 0.5 m). The sonic anemometer gave measurements of turbulence inside

the vortex flow field and indications of vertical variations in the ambient headwind and temperature, which were brought down to the measurement level by the descent of the vortex recirculation oval. In general, under conditions of low to moderate turbulence, the turbulence level inside the wake vortex flow field is greater than that in the ambient wind. The vertical anemometer array showed that the crosswind profile under a wake vortex in ground effect has a boundary layer much thinner than that of the ambient wind.
Author (AIAA)
Vortices; Aircraft Wakes; Ground Effect (Aerodynamics); Vortex Breakdown; Flow Measurement

19980055844
Re-engineering of the spin-damping and Magnus measurement technique at the Arnold Engineering Development Center (AEDC)
Marquart, E. J., Sverdrup Technology, Inc., USA; Heim, E. R., Sverdrup Technology, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0611; Copyright; Avail: Aeroplus Dispatch

The spin-damping and Magnus measurement technique has been re-engineered at the Arnold Engineering Development Center (AEDC) to adapt to today's environment of reduced resources available for testing and reduced development time for new systems. The measurement technique provides the capability of simultaneously acquiring static stability and drag performance data along with dynamic spin-damping and Magnus data, and consequential reductions in test cost and schedule. This has been accomplished primarily by replacing the original Magnus and spin-damping dynamic hardware four-component balance (having increased sensitivity in the side-force direction but neither rolling-moment nor axial-force components) with a standard six-component force and moment balance. Spin-damping and Magnus data were acquired in the Aerodynamic Wind Tunnel 4T at AEDC using the re-engineered measurement technique for the first time in 1996. This paper provides documentation of an uncertainty analysis of the spin-damping and Magnus test data that were acquired with the re-engineered process and a comparison of the results of the analysis with repeatability data and with estimates of data uncertainty from previous tests that used the special four-component Magnus balance.
Author (AIAA)
Magnus Effect; Damping; Spin; Roll

19980055860
The Hypervelocity Wind Tunnel No. 9 - Continued excellence through improvement and modernization
Marren, Dan E., Arnold Engineering Development Center, USA; Lafferty, John F., Arnold Engineering Development Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0631; Copyright; Avail: Aeroplus Dispatch

The Hypervelocity Wind Tunnel No. 9 located at the White Oak, MD site of the Arnold Engineering Development Center (AEDC) formerly the Naval Surface Warfare Center (NSWC) has long been recognized as a unique world class ground test facility. The facility was developed in the early 1970's as the latest in ground test facilities to provide critical low altitude, high Mach number data in support of the Navy's reentry development programs. Since its inception, Tunnel 9 has maintained a leading role in hypersonic ground testing by continually expanding its operational capabilities to match the needs of current and projected programs, maintaining data quality, and understanding customer requirements. Tunnel 9 started with a unique design built around a state-of-the-art high pressure supply heater that provided a clean, high pressure, high temperature nitrogen supply fluid. Initial operation realized a Mach 10 and 14 aerodynamic simulation capability and additional Mach 7, 8, and 16.5 high Reynolds number capabilities were developed. Each upgrade to Tunnel 9 during the past 20 years of operation has been in response to sponsor requirements supporting ballistic missile interceptor, strategic system, and hypersonic vehicle programs. These capability enhancements have helped maintain Tunnel 9's position as a core DoD hypersonic test and evaluation (T&E) ground test facility, which has been identified as a leading facility in all major hypersonic facility studies.
Author (AIAA)
Hypervelocity Wind Tunnels; Research and Development

19980055862
Aerodynamic calibration of the NASA Lewis Icing Research Tunnel (1997 tests)
Gonsalez, Jose C., NYMA, Inc., USA; Arrington, E. Allen, NYMA, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0633; Copyright; Avail: Aeroplus Dispatch

Aerodynamic calibration measurements and flow quality surveys were made in the test section of the Icing Research Tunnel at the NASA Lewis Research Center. These surveys were made following the installation of new water injecting spray bars in the settling chamber upstream of the test section. A single horizontally oriented rake was used to survey the flow field at several

vertical positions within a single cross-sectional plane of the test section. These surveys provided a detailed mapping of the total and static pressure, total temperature, Mach number, velocity, flow angle and turbulence intensity. Data were acquired over the entire velocity and total temperature range of the facility. No icing conditions were tested; however, the effects of air sprayed through the water injecting spray bars were assessed. All data indicate good flow quality. Mach number variations were less than 0.005, flow angles ranges were between 3 and 4 degrees, turbulence intensities were primarily between 0.4 percent and 1.0 percent. Test section total temperatures near the inner wall were warmer than in other parts of the test section. These warmer temperatures may be the result of poor inner cooler performance. Instrumentation and measurement uncertainties were also quantified.
Author (AIAA)
Aircraft Icing; Research and Development; Calibrating; Aerodynamic Characteristics

19980055863

Frequency response of a compressor test facility inlet

Grondin, J. W., USAF, Inst. of Technology, USA; Franke, M. E., USAF, Inst. of Technology, USA; Rabe, D. C., USAF, Wright Lab., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0634; Copyright; Avail: Aeroplus Dispatch

Pressure control at the compressor inlet of the Air Force Wright Laboratory Compressor Research Facility (CRF) is of primary interest in operating the facility under both steady and changing conditions. The resonance characteristics of the inlet duct can influence pressure control, especially under changing conditions. The response and resonant frequencies of the inlet duct of the CRF to a small-signal (acoustic) sinusoidal disturbance are determined for a variety of flow conditions. The fluid transmission line equations for laminar, 1D flow in a circular duct with cascaded lines of different diameters are solved and verified through comparisons with known theoretical results and a laboratory experiment using a scale model of the facility. Models for the effects of mean flow, end impedance and cascaded lines of different diameter are described. The fundamental frequency was found to be between 5.5 and 6.9 Hz, depending on flow conditions and facility configuration.
Author (AIAA)
Compressor Blades; Test Facilities; Frequency Response; Pressure Regulators; Cascade Flow

19980055864

Range extension for seven-holed probes

Thompson, Scott A., Lockheed Martin Aeronautical Systems, USA; Hackett, James E., Lockheed Martin Aeronautical Systems, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0635; Copyright; Avail: Aeroplus Dispatch

An investigation was conducted into the maximum attainable calibration angle for a 7-holed probe with a 60-deg cone angle. Detailed calibration maps were generated up to a flow angle of 105 deg. Additional limited data were acquired up to 160 deg. The maps were seen to ’roll over’ at approximately 85 deg, typical for this type of probe. This is usually considered to be the maximum range of the probe. However, the maps retain a useful shape for another 10-15 deg beyond this point. The difficulty lies in the fact that the map surface is dual-valued at high angles; the fold in the map is the 3D equivalent of the rollover point. This character of the maps provides the opportunity to extract valid data beyond rollover, but it also has ramifications in invalid point detection. In addition, a method for combining polar- and Cartesian-based maps was developed to improve the coherence of the maps at flow angles near 0 and 90 deg. Investigations into probe and map anomalies were also performed.
Author (AIAA)
Low Speed Wind Tunnels; Lockheed Aircraft; Wind Tunnel Calibration; Aircraft Wakes; Wind Tunnel Tests

19980055865

Pressure fluctuation measurements in the NAL 0.2-m supersonic wind tunnel

Sawada, Hideo, National Aerospace Lab., Japan; Kohno, Takashi, National Aerospace Lab., Japan; Kunimasu, Tetsuya, National Aerospace Lab., Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0636; Copyright; Avail: Aeroplus Dispatch

Pressure fluctuations were measured around the NAL 0.2-m supersonic wind tunnel circuit with a microphone and pressure transducer. The rms value of the fluctuations decreases by 20 dB between the compressor and the settling chamber exits. The ratio of the rms value of the fluctuations to the total pressure remains under 0.1 percent (in a 0.125 to 100 kHz bandwidth) at all test section Mach numbers from 1.5 to 2.5. This fact suggests that an axial flow compressor can be used for a quiet wind tunnel. The comparison between the measured and calculated local Mach number and flow angle distributions suggests that the wall boundary layers are not turbulent for all conditions. The pitot pressure fluctuations at the test section center increase rapidly and diverge from that in the settling chamber exit, when the test section Mach number increases beyond 1.8. This fact suggests that some phe-

nomenon producing fluctuations, like eddy Mach wave radiation, has originated in the nozzle. Also, the pressure fluctuation power spectrum density remains the same between the settling chamber exit and the test section, below Mach 1.8. The tunnel will be improved (made quiet) by introducing new nozzle contours and decreasing the side wall roughness.
Author (AIAA)
Supersonic Wind Tunnels; Pressure Oscillations; Pressure Measurement; Wind Tunnel Tests; Boundary Layer Flow; Power Spectra

19980055866

Case study - The expanding role of the PC based data acquisition system

Swinford, Scott, Pacific Instruments, USA; Buckley, Mark, Micro Craft, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0637; Copyright; Avail: Aeroplus Dispatch

This paper presents an overview of a recent installation of a data acquisition system (DAS) at the Micro Craft Low Speed Wind Tunnel (LSWT) in San Diego, CA and the technical issues surrounding the implementation and integration of the system. It discusses the requirements for the new system and the methods of providing for those requirements with a PC-based DAS.
Author (AIAA)
Low Speed Wind Tunnels; Data Acquisition; Pressure Measurement; Wind Tunnel Tests; Pressure Oscillations; Personal Computers

19980055919

Scale model Icing Research Tunnel validation studies

Canacci, Victor A., NYMA, Inc., USA; Gonsalez, Jose C., NYMA, Inc., USA; Spera, David A., NYMA, Inc., USA; Weaver, Hal F., NASA Lewis Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0706; Copyright; Avail: Aeroplus Dispatch

Major modifications are planned in the 1.8 m by 2.7 m Icing Research Tunnel (IRT) at NASA-Lewis, including replacement of its heat exchanger and associated ducts and turning vanes, and the addition of fan outlet guide vanes (OGVs). A 1/10-scale model of the IRT (designated the SMIRT) with and without these modifications was constructed and tested to increase confidence in obtaining expected improvements in flow quality around the tunnel loop. This paper describes the SMIRT as an aerodynamic test facility, and its qualification as a scaled representation of the flow patterns in the IRT. Test data defining flow profiles across a representative cross-section downstream of the fan are presented for both the IRT in its current (baseline) configuration and for the SMIRT in both baseline and modified configurations, with and without simulated OGVs. Flow distribution in the SMIRT is shown to be an accurate representation of that in the IRT. In addition, the simulated OGVs greatly improved the uniformity of flow downstream of the SMIRT fan, leading to the projection that the installation of fan OGVs in the IRT may reduce current flow distortions immediately downstream by 2/3.
Author (AIAA)
Scale Models; Wind Tunnel Tests; Aircraft Icing; Ice Formation; Wind Tunnel Apparatus; Guide Vanes

19980055920

Real-time wall interference correction system of the 12 ft pressure wind tunnel

Ulbrich, N., NASA Ames Research Center, USA; Boone, A. R., NASA Ames Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0707; Copyright; Avail: Aeroplus Dispatch

An improved version of the Wall Signature Method has been developed for the real-time Wall Interference Correction System (WICS) of the NASA-Ames 12-ft Pressure Wind Tunnel (PWT). Application of WICS to a semispan model test configuration is discussed. A singularity representation of the semispan model is used. Fuselage, propulsion simulator, and separation wake volume blockage effects are represented by point sources and sinks. Lifting effects are represented by semiinfinite line doublets. The location of a test article singularity is selected by using simple rules of thumb. The strength of a test article singularity is derived from lift force, propulsion simulator thrust force, or wall pressure measurements. Wall interference corrections are computed by combining the singularity representation of the test article with precomputed perturbation velocities of the interference flow field. Experimental data obtained during the test of a semispan model in the NASA-Ames 12 ft PWT are applied to WICS. Wall interference corrections are computed for different angle of attack settings. The solid volume blockage factor and angle of attack correction agree well with classical corrections. As expected, predicted separation wake blockage effects are smaller than corresponding classical corrections.
Author (AIAA)
Aerodynamic Interference; Wind Tunnel Tests; Real Time Operation; Semispan Models; Wind Tunnel Walls

19980055922

Automated wind tunnel testing

Schoenfeld, William P., Standard Missile Co., L.L.C., USA; Priolo, Francis J., Standard Missile Co., L.L.C., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0709; Copyright; Avail: Aeroplus Dispatch

Wind tunnel testing was recently conducted to determine the nondimensional aerodynamic stability and control characteristics of a slender body having low aspect ratio wings and aerodynamic tail control surfaces. Testing incorporated recent advancements in portable computers, innovations in wind tunnel model design, and upgrades to the Arnold Engineering Development Center Von Karman Fluid Dynamics Facility tunnel A, which provided remote control of the model configuration and aerodynamic attitude while the tunnel was operating. A mix of 80 x 86 and M680 x 0 architectures (IBM-PC clones and Apple Macintosh desk top and lap top computers) on a dedicated local network provided mass storage sharing for easy access to data, graphs, reports, run logs, and other pertinent reference material during testing. Data was passed from the facility computers to the user network over Ethernet within a few minutes of capture, for near-real-time analysis of the airframe. On-the-fly modifications to the test plans saved the time and expense of repeating a tunnel entry. Data was collected as fast as one sweep-mode run/min and compared to pause mode with no detectable differences in force and moment coefficients.

Author (AIAA)

Wind Tunnel Tests; Automatic Test Equipment; Aerodynamic Stability; Slender Bodies; Low Aspect Ratio Wings

19980055924

Design and checkout of a high speed research nozzle evaluation rig

Castner, Raymond S., NASA Lewis Research Center, USA; Wolter, John D., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0711; Copyright; Avail: Aeroplus Dispatch

The High Flow Jet Exit Rig was designed to provide simulated mixed flow turbojet engine exhaust for 1/7-scale models of advanced High Speed Research (HSR) test nozzles. The new rig was designed to be used at NASA-Lewis in the Nozzle Acoustic Test Rig (NATR) and the 8 x 6 Supersonic Wind Tunnel. Capabilities were also designed to collect nozzle thrust measurement, aerodynamic measurements, and acoustic measurements when installed at the NATR. Simulated engine exhaust can be supplied from a high pressure air source at 33 lb of air/sec at 530 R and nozzle pressure ratios of 4.0. In addition, a combustion unit was designed from a J-58 aircraft engine burner to provide 20 lb of air/sec at 2000 R, also at nozzle pressure ratios of 4.0. These airflow capacities were designed to test HSR nozzles with exhaust areas from 18 to 22 sq in. Nozzle inlet flow measurement is available through pressure and temperature sensors installed in the rig. Research instrumentation on HSR nozzles is available with a maximum of 200 individual pressure and 100 individual temperature measurements. Checkout testing was performed in May 1997 with a 22 sq in. ASME long radius flow nozzle. Checkout test results are summarized and compared to the stated design goals.

Author (AIAA)

Supersonic Nozzles; Nozzle Design; Test Stands; Wind Tunnel Models; Nozzle Flow

19980055926

Applications of modern experiment design to wind tunnel testing at NASA Langley Research Center

DeLoach, Richard, NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0713; Copyright; Avail: Aeroplus Dispatch

A 'modern design of experiments' approach to wind tunnel testing is under evaluation at NASA-Langley which differs from conventional 'one factor at a time' pitch-polar test designs in certain fundamental ways. This paper outlines the differences, both philosophical and procedural, in the two design methodologies, and compares results obtained using both methods in specific wind tunnel tests. Comparisons are made of the relative costs to achieve the same technical objective, where comparisons are made in terms of wind-on minutes, data volume, and electrical power consumption. Designed experiments appear to have the potential for saving as much as one-third to one-half of the wind-on minutes of conventional pitch-polar tests, and one-quarter to one-third of the wind-on costs. At the same time, they increase precision by removing 'block effects' from the unexplained variance in test results and illuminate interaction effects that cannot be quantified when variables are changed one-at-a-time.

Author (AIAA)

Experiment Design; Wind Tunnel Tests

19980056028

A comprehensive approach to flight test training using ground-based and airborne simulation

Miller, Robert V., U.S. Naval Test Pilot School, USA; King, Joseph T., U.S. Naval Test Pilot School, USA; Gordon, Vernon C.,

Veda, Inc., USA; Michael, William D., Veda, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0825; Copyright; Avail: Aeroplus Dispatch

This paper details the design and implementation of several example exercises of the curriculum of the U.S. Naval Test Pilot School (USNTPS). This 11-month curriculum teaches the theory and practical knowledge necessary for the test and evaluation of the airframe, associated flight systems, and an array of airborne mission systems. Graduates conduct research, development, test and evaluation for the DOD and civilian agencies. The educational flow begins with academic instruction in the classroom, followed by laboratory or ground simulation exercises, in-flight demonstration and unsupervised student practice. The culmination of this process is a flight test evaluation in state-of-the-art operational systems. Following the demonstration flights, the student performs similar evaluations of operational tactical aircraft and airborne systems. The school has developed specialized ground simulators and in-flight aircraft laboratories; the student evaluator can relate the impact that changes to system engineering parameters have on the mission capability of the system. Two USNTPS student exercises are presented which illustrate the instructional approach.
Author (AIAA)
Education; Test Pilots; Training Analysis

19980056179
Application of Neural Networks to tunnel data analysis
Lo, Ching F., Tennessee, Univ., Tullahoma, USA; Shi, George Z., Sverdrup Technology, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1004; Copyright; Avail: Aeroplus Dispatch

A method of Artificial Neural Networks is applied to mapping tunnel data of an energy efficient transport model from NASA/LaRC such that the procedure of data interpolation, configuration optimization and parametric study can be carried out efficiently. The application of Neural Networks to several other aspects of wind tunnel data acquisition and analysis is also recommended.
Author (AIAA)
Wind Tunnel Tests; Neural Nets; Data Acquisition; Aircraft Engines; Wing Span

19980056502
Wake visualization of a full-scale tilt rotor in hover
Lau, Benton H., NASA Ames Research Center, USA; Wadcock, Alan J., Sterling Software, USA; Heineck, James T., NASA Ames Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The laser light sheet technique was used to visualize the wake geometry of a full-scale XV-15 tilt rotor in hover in the 80- by 120-Foot Wind Tunnel at NASA/Ames. The vortex trajectories of the baseline rotor was measured for rotor thrust coefficient of 0.105 and hover tip Mach number of 0.69. Measurements also include results from blade-tip-mounted subwings with two different incidence angles. Vortex trajectories of the two subwing rotors were compared with that of the baseline rotor. For each subwing rotor, the laser sheet illuminates a vortex pair that rotates in the same direction. The trailing vortex generated by the subwing appears to be weaker than that of the main blade. As the vortex pair is convected downstream, the two vortices rotate relative to each other approximately half a revolution in 75-deg blade rotation. Subsequently, the vortex pair combines into a single vortex between 150- and 165-deg wake age. Both subwing vortices contract faster than their main-blade vortices. The combined vortices of both subwing rotors have the same trajectory as that of the baseline rotor. Vortex trajectory for the baseline rotor is also compared with a helicopter prescribed wake model. Both subwing rotors show a small improvement in hover performance over the baseline rotor.
Author (AIAA)
XV-15 Aircraft; Aircraft Wakes; Flow Visualization; Wind Tunnel Tests; Vortices

19980056778
Gasdynamical detectors of driver gas contamination in a high-enthalpy shock tunnel
Sudani, Norikazu, National Aerospace Lab., Japan; Hornung, Hans G., California Inst. of Technology, Pasadena; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 313-319; In English
Report No.(s): AIAA Paper 97-0561; Copyright; Avail: Aeroplus Dispatch

Simple gasdynamical devices consisting of a duct and a wedge have been applied to the detection of driver gas arrival in the test section of a high-enthalpy shock tunnel. Static pressure in the duct has been measured during a shot, and the time of driver gas arrival has been determined by the onset of the pressure rise, which indicates duct flow choking. The ability to detect driver gas in small concentrations is critical to the satisfactory performance of the device. Duct internal flows for various wedge angles have been numerically simulated to clarify the flow choking mechanism. The simulations give an idea of the improvement of detector sensitivity, and modified configurations of the detector are proposed. Flow visualization in the duct leads to a better under-

standing of pressure traces obtained, and pressure measurement data show a satisfactory degree of sensitivity. The arrival time of driver gas measured with the detectors is in good agreement with an analytical prediction based on a shock-bifurcation flow model. The useful test time in T5 with uncontaminated freestream is also demonstrated over a wide range of specific reservoir enthalpies.
Author (AIAA)
Shock Tunnels; Gas Dynamics; Hypervelocity Flow; Exhaust Gases; Environment Pollution

19980056785

Force measurements in hypersonic impulse facilities

Stoerkmann, V., Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany; Olivier, H., Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany; Groening, H., Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 342-348; In English; Copyright; Avail: Aeroplus Dispatch

A six-component strain gauge balance is used to measure aerodynamic loads of different models in hypersonic wind tunnels with running tunes down to 1 ms. Three models are employed, a pointed cone, an Apollo CM capsule, and a delta wing configuration, ELAC I. All models are tested in the Aachen shock tunnel TH2; the capsule model was additionally tested in the von Karman Institute Longshot facility. Two different methods are applied to compensate for low-frequency inertia forces caused by the model support system for the capsule tests. The measured aerodynamic coefficients are compared with experimental and numerical values of other authors.
Author (AIAA)
Hypersonic Wind Tunnels; Aerodynamic Loads; Strain Gages; Aerodynamic Forces

19980056793

Detrimental effects of almost immeasurably small freestream nonuniformities generated by wind-tunnel screens

Watmuff, Jonathan H., MCAT, Inc., USA; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 379-386; In English Report No.(s): AIAA Paper 97-0228; Copyright; Avail: Aeroplus Dispatch

Measurements are presented that were obtained in a series of flow quality improvements to a small stand-alone wind tunnel that has been modified for boundary-layer transition studies. The objective of establishing a Blasius boundary layer with a high degree of spanwise uniformity has been frustrated by the persistence of Klebanoff modes. The vortices originate at the leading edge and appear to be caused by almost immeasurably small nonuniformities in the freestream introduced by the wind-tunnel screens. The vortices cause a spanwise thickening and thinning of the layer. Contours of the background unsteadiness in a spanwise plane through the layer show locally concentrated regions with elevated levels that are associated with the vortices. These contours are used as a sensitive indicator for the flow quality improvements. Although far from forming a complete parametric study, the observations should act as a valuable guide for others. For example, spanwise variations in the porosity of the screens were discovered by traversing each screen between a laser and a photo detector. Significant improvement in the spanwise uniformity of the layer was obtained by sorting the screens based on these results. The quantities that are generally agreed upon to define acceptable flow quality proved to be inadequate during the final stages of refinement. The background unsteadiness within the layer has been reduced by a factor of 30 compared with the initial configuration.
Author (AIAA)
Nonuniform Flow; Wind Tunnel Tests; Boundary Layer Transition; Free Flow; Flow Distortion; Vortices

19980057764

Some aspects of centrifugal fan characteristics in blower windtunnels

Johnson, A. E., Surrey, Univ., UK; Hancock, P. E., Surrey, Univ., UK; Aeronautical Journal; Dec. 1997; ISSN 0001-9240; Volume 101,, no. 1010, pp. 481-485; In English; Copyright; Avail: Aeroplus Dispatch

Measurements have been made in the exit flows of the fan, diffuser, settling chamber and contraction of a low speed blower wind tunnel driven by a centrifugal fan. A velocity deficit and streamwise vortex were observed at the diffuser exit when the fan was operating at less than about 0.9 of maximum efficiency but not when operating above. Unacceptably large unsteadiness (about 0.7 percent rms) occurred at low speeds when the fan speed was increased from rest, but not when the fan speed was decreased from full speed. This unsteadiness was at the rotor frequency, and appears to have been caused by laminar boundary layer separation on one or more adjacent airfoil blades, coupled with slight asymmetry in the rotor. Unsteadiness at the rotor frequency and of comparable magnitude has also been seen in another, larger fan, but was not eliminated in the same way. Attaining high quality flow is likely to require careful attention to the characteristics of individual fans.
Author (AIAA)
Centrifugal Force; Wind Tunnel Tests; Blowers; Flow Characteristics; Flow Velocity; Boundary Layer Separation

19980058017

Tankers

Pennington, Reina J., USA; Air & Space; Nov. 1997; ISSN 0886-2257; Volume 12, no. 4, pp. 24-37; In English; Copyright; Avail: Aeroplus Dispatch

The history of aerial refueling is briefly reviewed, from the first transfer of gas between two flying aircraft in 1921 to military aerial refueling experience during operation Desert Storm. A chronology of major developments in aerial refueling is presented. Finally, the lessons learned during Desert Storm and the future of the Air Force refueling fleet are discussed.

AIAA

Air to Air Refueling; Tankers

19980058409

Surface pressure measurement in a cryogenic wind tunnel by using luminescent coating

Asai, Keisuke, National Aerospace Lab., Japan; Kanda, Hiroshi, National Aerospace Lab., Japan; Cunningham, Corey T., Purdue Univ., USA; Erausquin, Rick, Purdue Univ., USA; Sullivan, John P., Purdue Univ., USA; 1997, pp. 105-114; In English; Copyright; Avail: Aeroplus Dispatch

In recent experiments, we demonstrated the feasibility of using luminescent coatings for surface pressure measurement in a cryogenic wind tunnel. This technique is based on a new coating technology in which luminescent molecules are directly deposited onto the model surface by an electrochemical process. The resulting coating has an extremely high oxygen sensitivity for mole fractions of oxygen less than 0.1 percent. This capability allows us to measure the pressure field on the model surface in a cryogenic wind tunnel. To demonstrate this technology, a 14 percent-thick bump model was tested in the 0.1-m Transonic Cryogenic Wind Tunnel at NAL. Mach number was changed from 0.4 to 0.84 whereas temperature was maintained at 100 K. A small amount of oxygen was injected into the tunnel and the mole fraction of oxygen in the test gas was kept constant. We acquired two intensity images, one taken at low speeds and the other taken at high Mach numbers. by taking the ratio of these images, surface pressure distributions on the model were clearly captured. The result of the in situ calibration showed that effects of temperature dependence of the coating was negligible. The paint-derived pressure distributions are in good agreement with pressure tap measurements.

Author (AIAA)

Pressure Measurement; Pressure; Cryogenic Wind Tunnels; Coatings; Luminescence

19980058415

Wall adaptation and determination of residual wall interferences for a 2D and a 3D model in the transonic wind tunnel TWG of DLR

Holst, Hartmut, DLR, Germany; Bock, K.-W., DLR, Germany; 1997, pp. 174-184; In English; Copyright; Avail: Aeroplus Dispatch

The transonic wind tunnel TWG of DLR Goettingen has been modernized with respect to an improved flow quality as well as to the logistics of exchangeable test sections, operational reliability and productivity. It is presently equipped with a Laval nozzle (supersonic), a perforated test section (transonic) and a 2D adaptive (subsonic) test section. The latter can perform 2D adaptive tests on wing profiles using the Cauchy integral formula for wall adaptation, as well as 2D wall adaptation for 3D models utilizing the Wedemeyer/Lamarche (VKI) procedure. For both cases the wall adaptation was successful. The 3D force results compare quite well nominally interference-free results and to results from another adaptive test section. The pressure distribution from the wing profile tests agree quite well with theoretical results. For the 3D model, residual wall interferences were determined. It was found that the wall interferences had been reduced to nearly zero on the centerline of the test section by wall adaptation. Spanwise averages of the residual wall interferences have been used for further corrections.

Author (AIAA)

Wind Tunnel Walls; Transonic Wind Tunnels; Wind Tunnel Models; Wind Tunnel Apparatus

19980058417

Miniature rotating amplifier system for windtunnel application packs 256 pre-conditioning channels in 187 cubic inch

Versteeg, Maarten H. J. B., National Aerospace Lab., Netherlands; Slot, H., National Aerospace Lab., Netherlands; 1997, pp. 195-201; In English; Copyright; Avail: Aeroplus Dispatch

For a NASA windtunnel model NLR developed a 256 channel pressure sensor signal conditioning and amplifier system. This system was to be mounted within the rotating part of the model in a volume of 7 inches diameter and less than 6 inches long. The development of this system, called Rotating Amplifier System (RAS), required a close cooperation between electrical and mechanical designers to meet all customer requirements. For all 256 channels the bridge supply voltage, offset, and gain are sepa-

rately remote controllable to allow for adjustments during a running experiment. These configuration settings are loaded into the system using a dedicated serial link. For on-line calibration an R-Cal function is available with three separate resistor values. The mechanical construction of the RAS unit consists of a cylindrical unit that is mounted on the propeller shaft between gearbox and slip rings. The RAS unit is of modular design and consists 16 of identical modules, each containing 16 self-contained amplifier channels, sensor power supplies, and associated control logic. The amplifier system was realized using specially developed hybrid modules and packs the complete functionality in 187 cubic inch.
Author (AIAA)
Wind Tunnel Apparatus; Rotating Bodies; Amplifiers; Miniature Electronic Equipment; Channels (Data Transmission)

19980058418

Special 6-component jet rig balance for studying new thrust vectoring concepts

Ramaswamy, M. A., Indian Inst. of Science, India; Alvi, Farrukh S., Florida A & M Univ.; Florida State Univ., Tallahassee; Krothapalli, A., Florida A & M Univ.; Florida State Univ., Tallahassee; 1997, pp. 202-213; In English; Copyright; Avail: Aeroplus Dispatch

A new concept for efficient thrust vectoring of jet exhausts for aerospace applications, known as CounterFlow Thrust Vector (CFTVC) Control has been investigated at the Fluid Mechanics Research Laboratory (FMRL) over the past few years. Although pressure measurements and flow visualization results have proven the efficacy of this technique, it was felt that more direct measurements of the vectoring angles and thrust efficiency are needed to evaluate the CFTVC performance more rigorously. Therefore a special six-component balance to measure the main thrust as well as the lateral thrust, (which may be in any direction) was conceived, designed, and fabricated at FMRL. This paper provides complete details of the design, fabrication, assembly, calibration, and data reduction procedures of this balance. Some typical results obtained using this rig are also presented which clearly demonstrate the accuracy and usefulness of this instrument.
Author (AIAA)
Thrust Vector Control; Counterflow; Wind Tunnel Apparatus; Aerodynamic Balance

19980058422

An orbital platform rotary balance system for the IAR Water Tunnel

Cai, H. J., NRC of Canada, Inst. for Aerospace Research, Ottawa, Canada; Beyers, M. E., NRC of Canada, Inst. for Aerospace Research, Ottawa; O'Hagan, S., NRC of Canada, Inst. for Aerospace Research, Ottawa; 1997, pp. 236-245; In English; Copyright; Avail: Aeroplus Dispatch

A rotary balance apparatus based on the orbital platform concept has been developed for use in the IAR Water Tunnel. The new testing capability was introduced to generate a supplementary rotary data base for the F/A-18 aircraft required in a simulator fidelity enhancement study. The F/A-18 model was tested in steady coning motion at angles of attack from 0 deg to 90 deg and nondimensional rotation rates from 0 to +/- 0.3. The paper focuses on the new rotary balance testing methodology. Samples of the results are presented to illustrate the uniqueness of the new rotary data base. Agreement with existing wind tunnel data is generally good. Support interference effects in the conventional rotary apparatus were found to be small for this aircraft configuration.
Author (AIAA)
Hydraulic Test Tunnels; Rotor Dynamics; Space Platforms; Balance; Methodology

19980058424

Recent applications of particle image velocimetry in large-scale industrial wind tunnels

Willert, C., DLR, Inst. fuer Stroemungsmechanik, Germany; Raffel, M., DLR, Inst. fuer Stroemungsmechanik, Germany; Kompenhans, J., DLR, Inst. fuer Stroemungsmechanik, Germany; 1997, pp. 258-266; In English; Copyright; Avail: Aeroplus Dispatch

A variety of particle image velocimetry (PIV) systems for use in industrial wind tunnels have been developed at DLR in the past decade. The recent introduction of digital imaging allows a rapid availability of the PIV data and feedsback during tunnel operation. The flexibility of these portable systems is illustrated by presenting several results of recent PIV applications: (1) blade/vortex interactions on a model helicopter rotor, (2) the flow downstream of an aircraft model in landing configuration in the 6 x 8 sq m test section of the DNW Large Low Speed Testing facility (German-Dutch Wind Tunnel) and (3) the flow in the slat region of a 2D high-lift air-foil. In each case the advantage of PIV in providing instantaneous velocity maps is apparent when compared to the time-averaged result. Current development efforts of extending the PIV method to provide 3D data in wind tunnel environments are also given.
Author (AIAA)
Particle Image Velocimetry; Wind Tunnels; Industries; Technology Utilization; Technology Transfer

19980058433

Measurement of the aerodynamic coefficients of re-entry vehicles in short duration hypersonic facilities

Paris, S., von Karman Inst. for Fluid Dynamics, Belgium; Charbonnier, J.-M., von Karman Inst. for Fluid Dynamics, Belgium; Stoerkmann, V., Aachen, Technical Univ., Germany; Masson, A., ONERA, Centre du Fauga-Mauzac, France; Bugeau, A., Dassault-Aviation, France; 1997, pp. 345-354; In English; Copyright; Avail: Aeroplus Dispatch

Measurements of aerodynamic forces and moments in short duration hypersonic facilities require the application of compensation techniques to remove inertial forces from the strain gauge balance data. Three compensation techniques are described and applied to reentry vehicle testing using sting-mounted strain gauge balances. Experiments are carried out in three European hypersonic wind tunnels with running times varying from 200 ms to 2 ms. The advantages, drawbacks, and limitations of each compensation method are illustrated and discussed. The critical analysis of the compensated results obtained allows the establishment of guidelines to ensure satisfactory accuracy levels in the measurement of aerodynamic coefficients in this particular type of facility.

Author (AIAA)

Aerodynamic Coefficients; Reentry Vehicles; Aerodynamic Forces; Instrument Compensation

19980058435

Developing a stress wave thrust balance for a hypersonic shock tunnel

Tuttle, S. L., Queensland, Univ., Australia; Simmons, J. M., Queensland, Univ., Australia; Mee, D. J., Queensland, Univ., Australia; 1997, pp. 362-368; In English; Copyright; Avail: Aeroplus Dispatch

The development of a thrust balance for the measurement of the net thrust produced in a scramjet nozzle is described. The balance has been designed and tested in the T4 shock tunnel at the University of Queensland. Numerical simulations of the balance and measurements made in the shock tunnel demonstrate that the thrust is correctly recovered when the loading in the nozzle is symmetric, but unexpected pressure asymmetry in some cases prevented successful recovery of the thrust.

Author (AIAA)

Shock Tunnels; Stress Waves; Supersonic Combustion Ramjet Engines; Supersonic Nozzles; Aerodynamic Balance; Hypersonic Wind Tunnels; Thrust

19980058437

Real gas flow characterization in the ONERA F4 high enthalpy wind tunnel

Sagnier, Philippe, ONERA, France; Verant, Jean-Luc, ONERA, France; Devezeaux, Dominique, ONERA, France; Mohamed, Ajmal K., ONERA, France; Masson, Alain, ONERA, France; 1997, pp. 378-388; In English

Report No.(s): ONERA, TP no. 1997-161; Copyright; Avail: Aeroplus Dispatch

The ONERA F4 Hot Shot wind tunnel provides hypersonic air flows at high enthalpy and high pressure total conditions. In such a wind tunnel, real gas effects are large yielding experimental difficulties to assess the test section free stream characteristics. Flow contamination was a problem for total enthalpy determination when using the first arc chamber configuration, made of copper and organic materials. This point has been dramatically improved with the new arc chamber made of carbon materials. Test section free stream knowledge is achieved by direct means involving optical techniques and by indirect means, i.e. through the numerical rebuilding of experiments on nozzle and standard model flows. The free stream flow is observed to be close to equilibrium on data like pressure or transational temperature, while nitric oxide concentration measurement is rather close to a nonequilibrium situation. The possibility to model such results is discussed. Finally, example of force measurements on a capsule model is given to compare real gas with perfect gas results.

Author (AIAA)

Gas Flow; Real Gases; Hotshot Wind Tunnels

19980058438

Wide bandwidth stagnation temperature measurements in vortical flows behind turbine vanes

Hogg, S. I., Leicester, Univ., UK; Gostelow, J. P., Leicester, Univ., UK; Carscallen, W. E., NRC of Canada, Inst. for Aerospace Research, Ottawa; Buttsworth, D. R., Oxford, Univ., UK; Jones, T. V., Oxford, Univ., UK; 1997, pp. 389-400; In English; Copyright; Avail: Aeroplus Dispatch

A new fast response measurement technique for total temperature, originally developed for testing in transient facilities, has been adapted and used to make turbine vane wake flow measurements in a continuously running linear cascade. The bandwidth of the new method approaches 100 kHz, and is a considerable improvement on previous techniques. The measurements show clear evidence of vortex shedding over a range of Mach numbers. The shedding is consistent with previous schlieren and wake pressure measurements. At subsonic exit Mach numbers, the total temperature data shows vortex shedding at a Strouhal number of just

above 0.2. This is consistent with data from other cascades. At supersonic exit conditions, the measurements show that the vortex shedding breaks down into a number of different intermittent shedding modes. This is also consistent with earlier results. The existence of strong vortex driven energy separation in the wake through the Eckert-Weise effect, in which temperatures are suppressed in the center and discrete ’hot spots’ appear towards the edges of the wake flow, is confirmed by the total temperature measurements. The new measurements are used to explain earlier results from the cascade which were thought to be anomalous.
Author (AIAA)
Bandwidth; Stagnation Temperature; Temperature Measurement; Vortices; Turbine Blades

19980058440

Design of a steady-state heat flux probe for measurements in an induction-heated plasma flow

Lumens, Jean-Francois, von Karman Inst. for Fluid Dynamics, Belgium; Bottin, Benoit, von Karman Inst. for Fluid Dynamics, Belgium; Carbonaro, Mario, von Karman Inst. for Fluid Dynamics, Belgium; 1997, pp. 410-419; In English; Copyright; Avail: Aeroplus Dispatch

The design of a steady-state heat flux probe for high-enthalpy plasma flows was performed using empirical and numerical methods. A commercial code has been used to assess the local heat transfer inside the probe at the stagnation point. The study led to the optimization of the cooling circuit geometry and to the quantification of the convective heat transfer coefficient. A minimal mass flow rate was thus defined to avoid local boiling. Classical uncertainty theory has been used to derive the maximum mass flow rate leading to the state-of-the-art uncertainty of 10 percent. It is shown that with the proposed geometry it is possible to obtain an uncertainty of 5 percent or less in the heat flux range. A method is proposed by which the operational chart of the probe can be drawn for any change in the design parameters. The chart is given for the present design.
Author (AIAA)
Heat Flux; Magnetohydrodynamic Flow; Induction Heating; Steady State; Temperature Sensors

19980058443

Current state and potentialities of hypersonic MHD-gas acceleration wind tunnels

Alfyorov, V. I., TsAGI, Russia; 1997, pp. 439-449; In English; Copyright; Avail: Aeroplus Dispatch

This review analyzes different designs of hypersonic MHD-gas acceleration wind tunnels. Main characteristics of the hypersonic wind tunnel of TsAGI and the results of its application to solve practical problems of aerodynamics are considered. The flow conditions over bodies in free flight are compared with those realized experimentally in the test section of the facility at the same flow velocities of about 8 km/s. The advantage of applying MHD-gas acceleration facilities to solve problems of developing and testing scramjets for TAV vehicles is demonstrated and the data on possible gas dynamic and electrodynamic parameters of these facilities and their design versions are presented. Finally, basic problems to be solved in developing hypersonic MHD-gas acceleration facilities are listed.
Author (AIAA)
Magnetohydrodynamics; Hypersonic Wind Tunnels; Plasma Accelerators; Technology Assessment

19980058444

Background and prediction of correct full-scale reproduction in wind tunnels as concerns gas dynamic parameters of hypervelocity atmospheric flights and scramjet combustion chamber conditions

Alfyorov, V. I., TsAGI, Russia; Dmitriyev, L. M., TsAGI, Russia; Yegorov, B. V., TsAGI, Russia; Markachev, Yu. Ye., TsAGI, Russia; Rudakova, A. P., TsAGI, Russia; 1997, pp. 450-459; In English; Copyright; Avail: Aeroplus Dispatch

The report analyzes possible schemes of aerodynamic rigs intended for reproducing gas dynamic parameters and chemical air composition as applied to the TAV trajectory with the indication of required stagnation parameters. Based on the calculation of physico-chemical processes taking place in nozzles of classical facilities it is inferred that the chemical air composition differs noticeably from the natural air composition even in solving the problem of producing and retaining the gas in the plenum chamber at ultrahigh temperatures and pressures. The analysis reveals a distinct advantage of MHD-gas acceleration facilities in solving the stated problem. A set of equations of magnetogasdynamics and multitemperature physico-chemical kinetics which underlie the computation program is presented. The channels of energy transport from the electromagnetic field to the gas at different gas densities are considered. Calculated data on gas acceleration regimes in a wide spectrum of initial conditions and electrodynamic parameters are presented. The altitude and velocity ranges are indicated which can be attained in different facility operation conditions.
Author (AIAA)
Gas Dynamics; Supersonic Combustion Ramjet Engines; Combustion Chambers; Wind Tunnel Apparatus; Hypersonic Vehicles; Hypervelocity Flow

19980058806 Nichols Research Corp., Arlington, VA USA

Remote Passive Road Ice Sensor System (RPRISS) ***Final Report, Jan. 1996 - Aug. 1997***

Reed, J., Transportation Research Board, USA; Barbour, B., Transportation Research Board, USA; Sep. 1997; 30p; In English
Report No.(s): PB98-128572; TRB/IDEA/ITS-34; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

RPRISS is a passive infrared (IR) imaging system that can detect the presence of even very thin layers of ice on a paved surfaced. The system can also accurately estimate road surface temperature and provide television-like surveillance of traffic in the area. It may have applications as a replacement or supplement to visible-light video surveillance system in ice-critical areas.
NTIS

Infrared Imagery; Ice; Roads; Remote Sensors; Light (Visible Radiation); Surface Temperature

19980058945

Comparison between measurements and modellings in the ONERA F4 Hot Shot Wind Tunnel

Sagnier, Philippe, ONERA, France; Verant, Jean-Luc, ONERA, France; Devezeaux, Dominique, ONERA, France; Masson, Alain, ONERA, France; Mohamed, Ajmal K., ONERA, France; ONERA, TP no. 1997-68; 1997; In English
Report No.(s): ONERA, TP no. 1997-68; Copyright; Avail: Aeroplus Dispatch

The ONERA F4 Hot Shot Wind Tunnel is now a performing and well calibrated high enthalpy wind tunnel, with a low level of flow contamination. Force and moment measurements are possible, due to run durations of about 200 ms at quasi-steady conditions. After a short presentation of the facility and of the measurement techniques used, examples of flow calibration results are given. Conclusions on the test section flow properties are drawn from comparisons with numerical rebuildings of calibration experiments. At high enthalpy, the nozzle flow is observed to be close-to-equilibrium, while the nozzle boundary layer is close to laminarity. Two examples of recent model test results at high enthalpy, one of them compared with a computation, show the low level of flow contamination, a typical problem of such a type of wind tunnel, and the evidence of real gas effects either on shock standoff distances or on pitching moment.
Author (AIAA)

Hotshot Wind Tunnels; Wind Tunnel Tests; Wind Tunnel Models; Calibrating

19980060887

Knowledge-based airport gate assignment system integrated with mathematical programming

Cheng, Yu, Nanyang Technological Univ., Singapore; Computers & Industrial Engineering; Sep, 1997; ISSN 0360-8352; Volume 32, no. 4, pp. 837-852; In English; Copyright; Avail: Issuing Activity

Airport gate assignment is the process of selecting and allocating aircraft to gates to create an assignment schedule, and it is one of the major functions of airport operations. With the increase of passenger traffic volumes and the number of flights, the complexity of this task and the factors to be considered have increased significantly, and efficient gate utilization has received considerable attention. This paper proposes a knowledge-based airport gate assignment system integrated with mathematical programming techniques to provide a solution that satisfies both static and dynamic situations within a reasonable computing time. A partial parallel assignment is introduced, which considers a group of aircraft and looks at all the available gates and then does the gate assignments by optimizing a multi-objective function, For the validation of the proposed approach, an example is used as a case study, and a prototype system with various functions has been developed inn microcomputer environment.
Author (EI)

Expert Systems; Mathematical Programming; Airports; Traffic; Knowledge Based Systems; Problem Solving

19980060990

Intelligent building system for airport

Ancevic, Mark, Worldwide Programs for Building Management Systems; ASHRAE Journal; Nov, 1997; ISSN 0001-2491; Volume 39, no. 11, pp. 31-32, 34-35; In English; Copyright; Avail: Issuing Activity

The Munich Airport's building management system (BMS) is an example of the degree to which a building complex's functions can be integrated for greater operational control and efficiency. Its distributed control system is designed to optimize the complex's unique range of functions, while providing a high degree of comfort, convenience and safety for airport visitors. The success of the airport's BMS demonstrates the potential advantages of intelligent building systems and proves the reliability and multitasking capacity of the UNIX platform for building automation.
EI

Air Conditioning; Air Cooling; Cooling Systems; Management Systems; Space Heating (Buildings); Buildings; Energy Policy; Active Control; Distributed Parameter Systems; Airports; UNIX (Operating System)

19980062081

Shallow-water flow around model conical islands of small side slope. II: Submerged

Lloyd, Peter M., Univ. of Manchester, UK; Stansby, Peter K.; Journal of Hydraulic Engineering; Dec, 1997; ISSN 0733-9429; Volume 123, no. 12, pp. 1068-1077; In English; Copyright; Avail: Issuing Activity

Experiments have been conducted to study the unsteady wakes of submerged conical islands. The islands used in the tests have side slopes ranging from 8.0 to 33.1 deg. Experiments in a shallow-water channel with a steady, subcritical free stream showed vortex shedding to occur in the wake when the water depth above the island apex was relatively small. Flow separation from positions near the island apex was found to be important in producing this unsteady wake. As the water depth was increased the shedding was observed to become less vigorous and eventually stop. All islands tested produced similar results with the angle of the island side slope exerting relatively little influence on the process. The results of wind tunnel visualization studies, which used a rigid top plate to produce the effect of fluid depth, support the results from the water channel. Pictures of the surface flow patterns produced on the islands by the wind action are presented. Two-dimensional (2D) and three-dimensional (3D) shallow-water numerical models with the hydrostatic pressure assumption have been run for comparison with the laboratory measurements. The complex 3D flow observed in the near wake provides a severe test for the models. Although both models were found to reproduce gross features of the submerged island wakes their mode of generation could be quite different in model and experiment.
Author (EI)

Shallow Water; Water Flow; Fluid Flow; Water; Wakes; Unsteady Flow; Channel Flow; Vortex Shedding

19980063002

A double-chamber vaporizing combustor with high temperature rise and uniform exit temperature field

Chen, Binglu, Northwestern Polytechnical Univ., China; Tang, Ming, Northwestern Polytechnical Univ., China; Wu, Erping, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 96-98; In Chinese; Copyright; Avail: Aeroplus Dispatch

A new type of combustor, a double-chamber vaporizing combustor, has been developed for the heating apparatus of heating calibration tunnel. Its average exit temperature can reach 1850 C, the highest temperature rise from inlet to exit can reach 1600 C. In addition, this combustor has many other excellent characteristics, such as constant exit temperature field.
Author (AIAA)

Combustion Chambers; Vaporizing; Flame Temperature; Wind Tunnel Calibration; Temperature Distribution; High Temperature

19980065141

S3MA supersonic test capabilites extension using half nozzles

Grandjacques, Michel, ONERA, Centre de Modane-Avrieux, France; ONERA, TP no. 1997-56; 1997; In English
Report No.(s): ONERA, TP no. 1997-56; Copyright; Avail: Aeroplus Dispatch

S3MA, an ONERA supersonic wind tunnel, has a test range from Mach 0.1 to Mach 5.5, with stagnation pressures from 0.1 to 7.5 bar and about ten interchangeable test sections with typical dimensions of 0.8 x 0.88 m. By applying elementary aerodynamic principles to symmetrical nozzles in S3MA, half nozzles have been produced at low cost, making it possible to extend the operating range of the wind tunnel. The half nozzles allow certain tests, particularly air intake tests, to be carried out without notable alteration of local Mach number distribution.
AIAA

Supersonic Wind Tunnels; Wind Tunnel Tests; Wind Tunnel Nozzles

19980065368

Jet-engine test cell augmenter performance

Kodres, C. A., U.S. Navy, Naval Facilities Engineering Service Center, USA; Murphy, G. L., U.S. Navy, Naval Facilities Engineering Service Center, USA; Journal of Propulsion and Power; Apr. 1998; ISSN 0748-4658; Volume 14, no. 2, pp. 129-134; In English; Copyright; Avail: Aeroplus Dispatch

The prime gauge of jet-engine test cell performance is the ability to provide repeatable results of the engine measurements. Based on this criterion, the U.S. military test cells are among the finest air-cooled turbojet test facilities in the world. But this high performance is being achieved at a relatively high cost. Switching from a round or obround augmenter tube to a square or rectangular tube will save up to 30 percent in construction and maintenance costs. Performance as well as cost, however, must be considered, and the objective of this work is to quantitatively assess the aerothermal performance of the rectangular tube. Round, square,

and rectangular augmenter tubes of similar dimensions are compared using a mathematical model of the U.S. Navy's standard jet-engine test cell. Both the square and rectangular tubes are found to be acceptable alternatives.
Author (AIAA)
Jet Engines; Test Facilities; Engine Tests

19980067152
WAH-64 Attack Helicopter Training Service
Board, Adrian, GKN Westland Helicopters, Ltd., UK; 1997, pp. 8.1-8.4; In English; Copyright; Avail: Aeroplus Dispatch

The WAH-64 Attack Helicopter Training Service is currently being established to meet the training requirements for air crew, ground crew, and maintenance technicians. A comprehensive training needs analysis has determined the necessary elements of the Training Service which includes high-fidelity simulators and maintenance training devices. The quality of the Training Service will directly affect the combat effectiveness of the weapon system.
Author (AIAA)
Military Helicopters; Training Evaluation; Flight Crews; Training Simulators; Ground Crews

19980067604
Flattops for the future
Lopez, Ramon, UK; Flight International; Oct. 07, 1997; ISSN 0015-3710; Volume 152,, no. 4594, pp. 50, 51; In English; Copyright; Avail: Aeroplus Dispatch

The final Nimitz-class nuclear carrier and the next-generation 'CVX' class of aircraft carrier are discussed. While crews for the Nimitz class are of the order of 3500 in the ship's company and an additionsl 2200 in an air wing, CVX crew number requirements are thought capable of a reduction of those figures by half. The dimensions and equipment of the CVX are largely dictated by the need to operate the F/A-18E/F aircraft, although the Joint Strike Aircraft will become available in several years.
AIAA
Navy; Aircraft Carriers; Technological Forecasting

19980067710
A proposed HIRF test facility for aircraft testing
Kempf, Diane R., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 4.2-22 to 4.2-25; In English; Copyright; Avail: Aeroplus Dispatch

Since the high power threat from friendly and foreign emitters continues to grow and the threat of high power microwaves is becoming more of a concern, the DOD has been interested in developing a capability to efficiently and thoroughly test aircraft for this High Intensity Radiated Field (HIRF) electromagnetic environment. There are technical challenges and safety concerns to test the EM immunity of aircraft. A hybrid Transverse Electromagnetic (TEM)/reverberation chamber has been proposed by NIST and pursued by the Army and the Navy. This paper discusses the general concept of a TEM/reverberation chamber, the work that has been done to develop one, and the plans by the Army and the Navy to build a TEM/reverberation facility.
Author (AIAA)
Test Facilities; Flight Tests; Electromagnetic Radiation; Electromagnetic Shielding; Defense Program; Reverberation Chambers

19980067711
Recent developments relevant to implementation of a hybrid TEM cell/reverberation chamber HIRF test facility
Lehman, T. H., Science and Engineering Associates, Inc., USA; Freyer, G. J., Science and Engineering Associates, Inc., USA; Crawford, M. L., Science and Engineering Associates, Inc., USA; Hatfield, M. O., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 4.2-26 to 4.2-30; In English; Copyright; Avail: Aeroplus Dispatch

A hybrid transverse electromagnetic (TEM) Cell/Reverberation Chamber has been proposed as a High Intensity Radiated Fields (HIRF) test facility for aircraft. The concept would provide a linearly polarized, plane wave electromagnetic test environment over the TEM frequency region. Over the reverberation chamber operating range the EM test environment would be isotropic and randomly polarized. The frequency interval between the TEM cell and the reverberation ranges is a transition region. The frequency region covered by the hybrid concept would be 10 kHz to 18 GHz. TEM cells and reverberation chambers provided different but well characterized test environments over their normal operating ranges. However, the transition region environment is not well characterized, and available data implies large uncertainties. This paper considers one of several approaches for dealing

with the transition region. The feasibility of the hybrid concept has been demonstrated in a small facility. The scaleability of TEM cells, reverberation chambers, and the hybrid concept to an aircraft sized facility is a major concern.
Author (AIAA)
Reverberation Chambers; Electromagnetic Radiation; Test Facilities; Linear Polarization; Plane Waves

19980067762

Production Support Flight Control Computers - Research capability for F/A-18 aircraft at Dryden Flight Research Center

Carter, John, NASA, USA; 1997, pp. 7.2-8 to 7.2-23; In English; Copyright; Avail: Aeroplus Dispatch

NASA Dryden Flight Research Center (DFRC) is working with the U.S. Navy to complete ground testing and initiate flight testing of a modified set of F/A-18 flight control computers. The Production Support Flight Control Computers (PSFCC) can give any fleet F/A-18 airplane an inflight, pilot-selectable research control law capability. NASA DFRC can efficiently flight test the PSFCC for the following four reasons: six F/A-18 chase aircraft are available which could be used with the PSFCC; an F/A-18 processor-in-the-loop simulation exists for validation testing; the expertise has been developed in programming the research processor in the PSFCC; and a well-defined process has been established for clearing flight control research projects for flight. This report presents a functional description of the PSFCC. Descriptions of the NASA DFRC facilities, the PSFCC verification and validation process, and planned PSFCC projects are also provided.
Author (AIAA)
Flight Control; F-18 Aircraft; Airborne/Spaceborne Computers

19980068023

Low cost excellence

Allen, Patrick, UK; Defence Helicopter; Dec. 1997; ISSN 0963-116X; Volume 16, no. 4, pp. 28-31, 33; In English; Copyright; Avail: Aeroplus Dispatch

This article discusses the UK’s Defence Helicopter Flying School (DHFS), which was formed on April 1, 1997 at Royal Air Force Shawbury, Shropshire, UK, and was formally opened nine days later. In order to achieve training cost reduction in line with the 1994 Defence Cost Studies, the DHFS provides a single location, common syllabus, private finance initiatives, with aircraft being supplied, owned, and maintained by a civilian contractor who bears the majority of the risks. After a demanding flyoff competition, the Eurocopter AS350BB (designated the Squirrel HT1/HT2) and the Bell 412EP (designated the Griffin HT1) were selected for the training fleet. A description of the DHFS training program is given.
AIAA
Low Cost; Pilot Training; Military Helicopters

19980068055

Operational experience and test results in the adaptive test section of the DLR transonic tunnel

Hoist, H., DLR, Germany; Bock, K.-W., DLR, Germany; Lorenz-Meyer, W., DLR, Germany; Oberdieck, F., DLR, Germany; Hermes, M., DLR, Germany; Aeronautical Journal; Nov. 1997; ISSN 0001-9240; Volume 101,, no. 1009, pp. 421-428; In English; Copyright; Avail: Aeroplus Dispatch

The transonic facility of DLR Goettingen (TWG) has been modernized with respect to an improved flow quality and flow simulation, as well as to the logistics of exchangeable test sections, operational reliability, and productivity. It is presently equipped with a Laval nozzle for supersonic flow measurements, a perforated test section for transonic measurements, and a 2D adaptive test section for subsonic measurements. The latter can perform 2D adaptive tests on wing profiles using the Cauchy integral formula for wall adaptation, as well as 2D wall adaptation for 3D models utilizing the Wedemeyer/Lamarche procedure, also known as the VKI method. For both cases, it is shown that the wall adaptation was successful. The 3D force results compare quite well to test results from the perforated test section as well as to nominally interference-free results. The pressure distribution from the wing profile tests compare quite well to theoretical calculations. In the course of wind tunnel modernization, the transonic facility of DLR Goettingen has been equipped with the new software system DeAs for data acquisition and control of experimental facilities. In this environment the wall adaptation programs had to be implemented. Before adjusting the computed wall shape, it had to be controlled in the loop for sufficient accuracy and tolerable bending stresses. A simplified FEM was used for this purpose.
Author (AIAA)
Transonic Wind Tunnels; Wind Tunnel Walls; Wind Tunnel Tests

19980068286

More safe landings ***Mit Sicherheit mehr Landungen***

DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 24-29; In German; Copyright; Avail: Aeroplus Dispatch

Intelligent systems being developed to ensure safer aircraft landings at airports are discussed. Attention is given to TARMAC (Taxi and Ramp Management and Control), a 4D 'Arrival Manager', flight path optimization using Flight Management Systems, the application of anthropotechnics and simulation, and vortex street warning systems.
AIAA
Flight Safety; Aircraft Landing; Flight Paths; Flight Management Systems; Aircraft Safety

19980068287
Wind tunnel test laboratory ***Versuchslabor Windkanal***
DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 30-33; In German; Copyright; Avail: Aeroplus Dispatch
The low-speed wind tunnel at Braunschweig, or NWB, is discussed. Measurement techniques and models used in the tunnel are examined. Attention is given to aircraft engine tests and automobile tests in the tunnel.
AIAA
Wind Tunnel Tests; Low Speed Wind Tunnels; Wind Tunnel Models; Engine Tests; Aircraft Engines

19980068290
Masters, machines, and model construction ***Meister, Maschinen un Modellbau***
DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 48, 49; In German; Copyright; Avail: Aeroplus Dispatch
The design and construction of wind tunnel models at DLR-Standort Braunschweig is discussed. A brief overview of the process from beginning to end is given.
AIAA
Wind Tunnel Models; Research and Development

19980068306
Test facilities for fundamental research in propulsion ***Installations d'essais pour les recherches fondamentales en propulsion***
Collin, G., ONERA, France; Dessornes, O., ONERA, France; Magre, P., ONERA, France; ONERA, TP no. 1997-32; 1997; In French
Report No.(s): ONERA, TP no. 1997-32; Copyright; Avail: Aeroplus Dispatch
Two test facilities were developed in the framework of scramjet studies, at the ONERA Palaiseau test site, to study the combustion of hydrogen in a supersonic flow. One is dedicated to fundamental studies on reacting mixing layers, and the second is more oriented towards the evaluation of injection devices or the study of a complete combustion chamber. These facilities and the associated instrumentation are described in this paper. The first results show their ability to perform supersonic combustion and to give information on the ignition delay of basic injectors.
Author (AIAA)
Test Facilities; Propellant Combustion; Supersonic Combustion Ramjet Engines; Supersonic Flow; Reacting Flow

19980068511
Test of a parafoil in ONERA's SIMA wind tunnel ***Essais d'un parafoil dans la soufflerie SIMA de l'ONERA***
Massonnat, Jean M., ONERA, France; Stojanowski, Marc, Dassault-Aviation, France; ONERA, TP no. 1997-40; 1997; In French
Report No.(s): ONERA, TP no. 1997-40; Copyright; Avail: Aeroplus Dispatch
Unlike classic circular parachutes, which principally consist of a tissue of simple thickness formed into a dome, a parafoil is characterized by a flexible and thick profile possessing an under surface, an upper surface, an angle of attack, and a flight angle, like the wing of an aircraft. ESA, in the framework of the ARD manned space capsule program, is interested in a parafoil-type parachute which has sufficient refinement, good maneuverability, and a tracking velocity which permits the precise landing of a manned recoverable space capsule. This paper reports on the testing by ONERA of a particular parafoil in the large transonic SIMA wind tunnel. The test assembly, measurement and testing techniques, and an overview of the measurements carried out are presented.
AIAA
Parafoils; Space Capsules; Reentry Vehicles; Wind Tunnel Tests

19980068662
Internal strain-gage balances - An international survey
Kilgore, Robert A., CES-Hampton, USA; 1997, pp. 1-8; In English; Copyright; Avail: Aeroplus Dispatch

The purpose of the survey was to gather information on how various organizations design, build, gage, calibrate, and use internal strain-gage balances. From the information gathered, I try to identify the best practices as well as areas where there is some agreement that improvements should be made. This paper gives highlights of the survey arranged according to activity, that is, design, building, gaging, calibration and so forth. It is difficult to draw any firm conclusions from the rather large amount of information gathered from this survey. However, several points seem reasonably clear from both the technical information and from the letters which often accompanied the direct response to the survey questions. (1) Everyone has problems of one kind or another with internal strain-gage balances. (2) Thermal gradients are a problem with most balances, not just with the unheated balances used with cryogenic wind tunnels. (3) No one balance group is ahead in all areas. (4) The use of automatic balance calibration machines is becoming almost commonplace. (5) All areas of balance technology - design, fabrication, gaging, calibration, and so forth - need to be carefully evaluated to determine what methods result in the best overall accuracy.
Author (AIAA)
Strain Gages; Technology Assessment; Calibrating; Balance

19980068663

Aspect of improving drag performance in a magnetic suspension wind tunnel

Lin, Chin E., Cheng Kung Univ., Taiwan, Province of China; Liu, K. H., Cheng Kung Univ., Taiwan, Province of China; Jou, H. L., Cheng Kung Univ., Taiwan, Province of China; 1997, pp. 9-15; In English; Copyright; Avail: Aeroplus Dispatch

The magnetic suspension balance system (MSBS) for wind tunnels has better characteristics against model support interference. For several developments, the MSBS technology may become useful if technical problems can be overcome. Of greatest concern to the MSBS for wind tunnels is drag capability under higher activated wind speeds. In the development of the MSBS, the idea of adding additional electromagnetic coils to generate additional longitudinal force to overcome high speed drag is proposed. In this paper, configurations of the original and the modified system models are presented. The drag performances of these two models are simulated using OPERA 3D. The simulation results are compared with experimental data from the original model to examine the reliability of the simulation. The modified system can be feasibly proven to have better capability to promote drag performance for high-speed tests.
Author (AIAA)
Magnetic Suspension; Wind Tunnels; Balance

19980068664

Experience during execution of the ITST project

Wiriadidjaja, Surjatin, Agency for the Assessment and Application of Technology, Indonesia; Sakya, Andi E., Agency for the Assessment and Application of Technology, Indonesia; Widodo, Wahjoe, Agency for the Assessment and Application of Technology, Indonesia; 1997, pp. 16-21; In English; Copyright; Avail: Aeroplus Dispatch

In September 1995, the Minister for Research, Science and Technology/Chairman of the Agency for the Assessment and Application of Technology (BPPT) assigned the Aero, Gasdynamics, and Vibration Laboratory (LAGG) to start the development of the Indonesian Transonic Speed Tunnel (ITST). ITST is intended to support the development of N-2130, a new jet aircraft family. The N-2130, as announced recently, is scheduled to be first flown in 2003. Thus, the ITST project faces a very tight schedule. Moreover, ITST is a complex facility, and the parts will be manufactured and procured in many places of the world; hence, various procurement, transportation, managerial, and organizational approaches are applicable. Under these circumstances it was considered that the most efficient way to handle the project is as an ’integrated owner-contractors managed project’. In this paper, experience during execution of the ITST project is presented and discussed.
Author (AIAA)
Transonic Wind Tunnels; Research and Development; Jet Aircraft; Indonesian Space Program

19980068665

Engineering design of Indonesian Transonic Speed Tunnel (ITST)

Cakrawala, A., Agency for the Assessment and Application of Technology, Indonesia; Hendriyono, W., Agency for the Assessment and Application of Technology, Indonesia; Martindale, B., Sverdrup Technology, Inc., USA; 1997, pp. 22-27; In English; Copyright; Avail: Aeroplus Dispatch

In the development of the Indonesian Transonic Speed Tunnel (ITST), the design of the internal circuit of the tunnel is discussed. All discussions are limited to aerodynamic aspects of internal circuits in terms of flow quality and power efficiency. Some analytical approaches to the determination of the most effective configuration of internal circuits elements, especially the Turbulence Reduction System (TRS) and the prediction of tunnel total loss and hence the driving power needed, are discussed. A TRS

arrangement using two screens and one honeycomb is the most preferred since it offers minimum total pressure loss with high flow quality for given tunnel operating conditions.
Author (AIAA)
Structural Design; Indonesian Space Program; Transonic Wind Tunnels

19980068666

Aerodynamic features of the Indonesian Transonic Speed Tunnel

Sakya, Andi E., Agency for the Assessment and Application of Technology, Indonesia; Tizard, John A., Agency for the Assessment and Application of Technology, Indonesia; 1997, pp. 28-32; In English; Copyright; Avail: Aeroplus Dispatch

This report provides information concerning the aerodynamic features of the Indonesian Transonic Speed Tunnel (ITST), which will be started operationally in 1999. The subject tunnel operates in transonic speed. This is in accord with the requirement from the national aircraft industry for the development of a new transonic type aircraft called N-2130. to ensure that the development testing using this tunnel can meet the schedule, the tunnel is furnished with interchangeable test sections. The design emphasizes productivity without jeopardizing flow quality, which is defined based on the best achievable tunnel flow qualities in the world.
Author (AIAA)
Indonesian Space Program; Transonic Wind Tunnels; Aerodynamic Characteristics; Supersonic Aircraft

19980068674

High amplitude oscillatory coning test in low speed wind tunnel

Gao, Jianjun, Harbin Aerodynamics Research Inst., China; Lou, Haiye, Harbin Aerodynamics Research Inst., China; Li, Zhongyi, Harbin Aerodynamics Research Inst., China; Qiu, Junwen, Harbin Aerodynamics Research Inst., China; 1997, pp. 77-89; In English; Copyright; Avail: Aeroplus Dispatch

The High Amplitude Oscillatory Coning Motion Balance (HAOCMB) is a dynamic test apparatus recently built in the FL-8 low speed wind tunnel of the Harbin Aerodynamics Research Institute. It provides a low-cost and effective tool for the establishment of a high-AOA aerodynamic data base to deal with the stall/poststall behavior of aircraft. The system equipment, acquisition, and data processing, evaluation of aerodynamic data, and results of comparisons with data from other test rigs are presented.
Author (AIAA)
Low Speed Wind Tunnels; Wind Tunnel Tests; Oscillating Flow; Aerodynamic Characteristics; Aerodynamic Stalling; Rotating Fluids

19980068677

Secondary linear blockage gradient corrections derived in a transonic adaptive flexible walled test section

Goodyer, M. J., Southampton, Univ., UK; Lewis, M. C., Southampton, Univ., UK; 1997, pp. 103-110; In English; Copyright; Avail: Aeroplus Dispatch

Measurements have been made of the effects of wall-induced blockage gradients at transonic speeds using the unusual features of adaptive wall test sections to control and allow quantification of wall interference. The model was an aft-loaded supercritical section with pressure tappings. An approach is outlined to assist in interpreting the information. Some of the aerodynamic effects of linear gradients on lift and pitching moment coefficients are included.
Author (AIAA)
Transonic Speed; Wind Tunnel Tests; Wall Flow; Pitching Moments

19980068678

A new adaptive wall test section for 3D wind tunnel testing

Chang, Byeong-Hee, Korea Aerospace Research Inst., Republic of Korea; Sung, Bongzoo, Korea Aerospace Research Inst., Republic of Korea; Chang, Keun-Shik, Korea Advanced Inst. of Science and Technology, Republic of Korea; 1997, pp. 111-118; In English; Copyright; Avail: Aeroplus Dispatch

A new adaptation algorithm of a 2D adaptive wall test section for 3D wind tunnel testing is proposed and evaluated through numerical tests. In this algorithm, the adapted wall shape is represented as a combination of two base streamlines. The combination coefficients are optimized in order to minimize the wall interference that is taken as the summation of the area-weighted surface pressure difference between the free air result and the test section result. The test section result obtained by this algorithm is very close to the free air result. The new adaptation algorithm does not need the target line and influence coefficients that are critical to the success of the conventional adaptation algorithms. Also, it is verified that the new adaptation algorithm can reflect the pres-

sure hole distribution and guarantee its convergence independent of the pressure hole distribution. This new adaptation algorithm may be applied to wind tunnel tests in which the optimum target line and pressure hole distribution cannot be predicted.
Author (AIAA)
Wall Flow; Wind Tunnel Tests; Three Dimensional Flow; Air Flow; Wing Profiles

19980068679

The research of design and testing technique on transonic flexible wall adaptive wind tunnel

Zuo, Peichu, Northwestern Polytechnical Univ., China; He, Jiaju, Northwestern Polytechnical Univ., China; 1997, pp. 119-126; In English; Copyright; Avail: Aeroplus Dispatch

This report describes progress made in testing 3D models in 2D transonic flexible-wall wind tunnels at high speed. It includes the design and parameter determination of transonic flexible wall adaptive wind tunnels, research on reducing shock wave reflection at low supersonic speeds, optimizing the test section parameters for extending wall interference-free or small wall interference testing regions at transonic speeds, and the testing technique of flexible-wall wind tunnel at near sonic speeds.
Author (AIAA)
Research and Development; Structural Design; Wall Flow; Transonic Wind Tunnels; Wind Tunnel Models; Aircraft Design

19980068849

Hardware-in-the-loop simulation at Wright Laboratory's Dynamic Infrared Missile Evaluator (DIME) Facility

Huber, Edward G., Jr., USAF, Wright Lab., USA; Courtney, Rebecca A., Science Applications International Corp., USA; 1997, pp. 2-8; In English; Copyright; Avail: Aeroplus Dispatch

The DIME Facility has been performing hardware-in-the-loop (HWIL) IR seeker exploitation and countermeasures development for over 30 years. A unique feature of this facility is the close integration of hardware exploitation, computer simulation, and HWIL testing, which facilitates feedback between predicted and actual seeker performance. This paper provides an introduction to the DIME Facility's HWIL testing approach and capabilities.
Author (AIAA)
Infrared Imagery; Missile Detection; Computerized Simulation; Test Facilities

19980068853

Low cost real-time infrared scene generation for image projection and signal injection

Buford, James A., Jr., U.S. Army, USA; King, David E., CG2, Inc., USA; Bowden, Mark, CG2, Inc., USA; 1997, pp. 48-57; In English; Copyright; Avail: Aeroplus Dispatch

At the U.S. Army Missile Command (MICOM) researchers have developed a dynamic IR scene generator (IRSG) built around commercial off-the-shelf (COTS) hardware and software. The IRSG is being used to provide inputs to an IR scene projector for in-band sensor testing and for direct signal injection into the sensor or processor electronics. Using this 'baseline' IRSG, up to 120 frames per second (Hz) of 12-bit intensity images are being generated at 640 x 640 pixel resolution. The IRSG SUT-to-target viewpoint is dynamically updated in real time by a 6-DOF SUT simulation executing on a facility simulation computer, synchronized with an external signal from the SUT hardware, and compensates for system latency using a special-purpose hardware component implemented on a single VME card. Multiple dynamic targets, terrain/backgrounds, countermeasures, and atmospheric effects in real time by the facility simulation computer via a shared memory interface to the IRSG. The 'next generation' IRSG is currently under development at MICOM using next-generation COTS hardware and software. Next-generation performance specifications are estimated to yield 16-bit intensity, 250-300-Hz frame rate, at 1024 x 1024 pixel resolution.
Author (AIAA)
Infrared Imagery; Signal Processing; Software Development Tools

19980068858

Now-term solutions to spatial, spectral, and temporal IR simulation with Wright Laboratory's Dynamic Infrared Missile Evaluator (DIME)

Courtney, Rebecca A., Science Applications International Corp., USA; Huber, Edward G., Jr., USAF, Wright Lab., USA; 1997, pp. 104-110; In English; Copyright; Avail: Aeroplus Dispatch

The introduction of spatial, spectral, and temporal discrimination in IR seekers has greatly increased the level of sophistication required of hardware-in-the-loop test facilities. In the long term, IR scene projectors offer promise of meeting many of these requirements. However, Wright Laboratory's Dynamic Infrared Missile Evaluator (DIME) Facility has ongoing requirements to

evaluate state-of-the-art IR seekers. This paper describes reliable and effective techniques integrated into the DIME to meet current requirements for testing seekers with spatial, spectral, and temporal discrimination capabilities.
Author (AIAA)
Missile Detection; Infrared Imagery

19980068859
Target Scene Generator (TSG) for infrared seeker evaluation
Sturlesi, Doron, RAFAEL, Electro Optics Dept., Israel; Pinsky, Ephi, RAFAEL, Electro Optics Dept., Israel; 1997, pp. 111-119; In English; Copyright; Avail: Aeroplus Dispatch

The TSG is used for evaluating IR missile seekers by dynamic targets and EOCM realistic environment. The system generates multimode primary and secondary targets, up to three flares, and jammers combined with thermal background image of 10 FOV. Each component is independently controlled to provide 2-D trajectory, velocity, and acceleration. Four orders of magnitude in LOS angular velocity can be accomplished. The system allows for variation of sources angular size, radiated intensity, and other spatial and temporal modulation. All sources are combined in a collimated output beam. The beam is further projected through an optical relay and a Field of Regard assembly. This mechanism displays the whole scenario in a wide-angle span onto the seeker aperture. Further system improvements involve combining dynamic IR scene projector with high temperature sources under real-time high dynamics, for better performances with imaging seekers of maneuvered platforms.
Author (AIAA)
Infrared Imagery; Projectors; Real Time Operation

19980068867
Real-time IR scene generation of aircraft targets
Crow, Dennis R., Kinetics, Inc., USA; Olson, Eric M., Science Applications International Corp., USA; Garbo, Dennis L., Science Applications International Corp., USA; Coker, Charles F., USAF, Wright Lab., USA; 1997, pp. 192-199; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents computational techniques to compute aircraft IR radiation imagery for high frame rate applications at the Kinetic Kill Vehicle Hardware-in-the-loop Simulator (KHILS) facility located at Eglin AFB. Details concerning the underlying phenomenologies are also presented to provide an understanding of the computational rationale. Finally, several example calculations are presented to illustrate the level of fidelity that can be achieved using these methods.
Author (AIAA)
Aircraft Detection; Real Time Operation; Infrared Imagery

19980068868
Real-time infrared signature model validation for hardware-in-the-loop simulations
Sanders, Jeffrey S., Simulation Technologies, Inc., USA; Peters, Trina S., Simulation Technologies, Inc., USA; 1997, pp. 200-208; In English; Copyright; Avail: Aeroplus Dispatch

Techniques and tools for validation of real-time IR target signature models are presented. The model validation techniques presented in this paper were developed for hardware-in-the-loop (HWIL) simulations at the U.S. Army Missile Command's Research, Development, and Engineering Center. Real-time target model validation is a required deliverable to the customer of a HWIL simulation facility and is a critical part of ensuring the fidelity of a HWIL simulation. The first level of real-time target model validation, comparison of the target model to some baseline or measured data which answers the question 'are the simulation inputs correct?', is dealt with. Tools that generate validation data for HWIL simulations at MICOM are described, and example real-time model validations are presented.
Author (AIAA)
Target Simulators; Infrared Signatures; Real Time Operation

19980068872
Rendering energy conservative scenes in real-time
Olson, E. M., Science Applications International Corp., USA; Garbo, D. L., Science Applications International Corp., USA; Crow, D. R., Kinetics, Inc., USA; Coker, C. F., USAF, Wright Lab., USA; 1997, pp. 250-259; In English; Copyright; Avail: Aeroplus Dispatch

Real-time IR scene generation for hardware-in-the-loop (HWIL) testing of IR seeker systems is a complex problem due to the required frame rates and image fidelity. High frame rates are required for current generation seeker systems to perform designation, discrimination, identification, tracking, and aimpoint selection tasks. This paper presents computational techniques per-

formed to overcome IR scene rendering errors incurred with commercially available hardware and software for real-time scene generation in support of HWIL testing. These techniques provide an acceptable solution to real-time IR scene generation that strikes a balance between physical accuracy and image framing rates. The results of these techniques are investigated as they pertain to rendering accuracy and speed for target objects which begin as a point source during acquisition and develop into an extended source representation during aimpoint selection.
Author (AIAA)
Energy Conservation; Real Time Operation; Infrared Imagery

19980068873

Real-time radiometric calculations utilizing SGI symmetric multiprocessing architecture

Makar, Robert J., Amherst Systems, Inc., USA; O'Toole, Brian E., Amherst Systems, Inc., USA; Rogers, Paul C., Amherst Systems, Inc., USA; 1997, pp. 260-270; In English; Copyright; Avail: Aeroplus Dispatch

An approach to utilize the symmetric multiprocessing environment of the Silicon Graphics (SGI) Onyx and Onyx2 has been developed to support the generation of IR scenes in real time. This development, supported by the Navy, is driven by a desire to maximize use of commercial-off-the-shelf (COTS) hardware and minimize cost and development time. An SGI-based Real-time Infrared Scene Simulator (RISS) system was developed to utilize the SGI's fast symmetric multiprocessing hardware to perform real-time IR scene radiance calculations for scene objects. This paper discusses the critical technologies that apply to IR scene generation and hardware-in-the-loop testing using COTS hardware. Specifically, the application of RISS high-fidelity real-time radiance algorithms on the SGI's symmetric multiprocessing hardware is discussed. Also, issues relating to the integration of the real-time algorithms with various rendering engines and external real-time control is addressed.
Author (AIAA)
Multiprocessing (Computers); Real Time Operation; Radiometric Correction; Infrared Imagery

19980068875

Ultraviolet scene simulation for missile approach warning system testing

Giza, Robert H., Amherst Systems, Inc., USA; Acevedo, Paul A., Amherst Systems, Inc., USA; Bliss, John D., Amherst Systems, Inc., USA; 1997, pp. 282-291; In English; Copyright; Avail: Aeroplus Dispatch

Ultraviolet extensions have been incorporated in the Real-time IR/EO Scene Simulator (RISS) to support hardware-in-the-loop (HWIL) testing of UV missile warning systems. Preliminary testing and validation of the UV rendering algorithms were performed. Simulated UV missile signatures were compared to measured static and free-flight test data. This work was performed to support the test and evaluation of modern missile warning systems at Wright Labs Integrated Defensive Avionics Lab. This paper discusses development of HWIL testing capability for UV missile warning receiver systems. Requirements for real-time UV simulation are defined, and a real-time architecture that addresses these requirements is discussed. Specifically, the development of real-time UV rendering algorithms to support modeling of atmospherics and backgrounds in the UV solar blind wavelength region is outlined. Issues regarding implementation of spatial UV scattering effects in a real-time rendering environment are addressed. Development of the UV sensor model, and its potential implementation in a real-time hardware/software direct injection device are illustrated. The results of some preliminary validation using laboratory and live firing test data are also discussed.
Author (AIAA)
Missile Simulators; Ultraviolet Radiation; Warning Systems; Flight Tests

19980068882

Visualization in hardware-in-the-loop simulation

Wilson, Mark A., Lockheed Martin Electronics and Missiles, USA; 1997, pp. 358-363; In English; Copyright; Avail: Aeroplus Dispatch

The Advanced Simulation Laboratory (ASL) at Lockheed Martin Electronics and Missiles in Orlando, Florida, has developed and integrated a suite of visualization tools designed to support and enhance hardware-in-the-loop simulation. State-of-the-art computer image generators with multiple channels and viewpoints using detailed, fully articulated models provide real-time views of the system under test. Workstations serve as symbol generators overlaying flight symbology and textual data on the virtual scene. A digital moving map displays mission progress, critical points and target symbology. A real-time data monitor program allows engineers to organize data logically for display during the run. National Instrument's LabView provides virtual gauges, meters, status indicators, and even stripcharts. The ASL visualization tools are fully integrated into the lab video system. As a result, all visualization channels can be recorded and routed to any display in the lab, including the multiscreen, multimedia dem-

onstration and briefing room. Video routing and host control for the image generators, symbol generators and digital map are under control of a real-time, scripted visualization control program.
Author (AIAA)
Computerized Simulation; Virtual Reality; Display Devices; Real Time Operation

19980068969

A synthetic approach for control of intermittent wind tunnel

Zhang, Guijun, Northeastern Univ., China; Chai, Tianyou, Northeastern Univ., China; Shao, Cheng, Northeastern Univ., China; 1997, pp. 203-207; In English; Copyright; Avail: Aeroplus Dispatch

For intermittent wind tunnel, the Mach number in test section is difficult to control because of unpredictable changes in wind tunnel process dynamics and restriction of air storage volume. to cope with the problem, a synthetic approach which combines adaptive and auto-tuning with feedforward control strategy is presented in this paper. The adaptive and auto-tuning controller with a recursive parameter estimation of a first-order or second-order model with delay is employed to control the transient and the steady state for the Mach number in test section changes and to solve the problem set point tracking and load disturbance rejection. The transient controller designed by the motion law method shows the excellent performance of set point tracking, and the steady state controller is of a PID type whose parameters are tuned by the SPAM tuning of rejecting load disturbance. The feedforward controller is used to compensate for the loss of air storage pressure. The experimental results of control of the Mach number in the test section and the injector total pressure for the electric wind tunnel of the new 2.4- x 2.4-m injector driven transonic wind tunnel demonstrate the effectiveness of the proposed controllers.
Author (AIAA)
Transonic Wind Tunnels; Adaptive Control; Parameter Identification; Feedforward Control; Electric Networks; Wind Tunnel Models

19980069135

Modelling and controller design for 2.4 m injector powered transonic wind tunnel

Yu, Wen, CINVESTAV-IPN, Mexico; Zhang, Guijun, Northeastern Univ., China; 1997, pp. 1544, 1545; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a new modeling and control method of a 2.4 m transonic wind tunnel by analyzing its special properties. Multivariable linearization models are first used for wind tunnel control, and a dual closed-loop controller is implemented to speed up the starting process.
Author (AIAA)
Transonic Wind Tunnels; Wind Tunnel Models; Feedback Control; Control Systems Design; Injectors; Multivariable Control

19980069436

Motion simulation capabilities of three-degree-of-freedom flight simulators

Pouliot, Nicolas A., Univ. Laval, Canada; Gosselin, Clement M., Univ. Laval, Canada; Nahon, Meyer A., Victoria, Univ., Canada; Journal of Aircraft; Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 9-17; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the results of a study aimed at determining the simulation realism that might be achieved using reduced-DOF flight simulator motion bases. More specifically, the quality of motion produced by two different three-DOF platforms was compared to that produced by a conventional six-DOF Stewart platform. The three-DOF motion bases investigated were a spherical mechanism allowing only rotational motions and a motion base capable of heave, pitch, and roll motions. to compare the different motion bases, three characteristic maneuvers were simulated using a nonlinear model of a Boeing 747. The aircraft motions were then simulated on nine different combinations of virtual motion platforms and motion base drive algorithms. The motion cues (specific forces and angular velocities) produced in this manner were then graphically compared. The analysis revealed that, in most cases, a three-DOF simulator is capable of producing motion simulation quality comparable to that produced by a six-DOF Stewart platform. Analysis of the motion sensations, as produced by a vestibular model, revealed nearly the same results as the motion analysis.
Author (AIAA)
Motion Simulation; Degrees of Freedom; Flight Simulators; Transport Aircraft

19980069448

New adaptive wall test section for three-dimensional wind-tunnel testing

Chang, Byeong-Hee, Korea Aerospace Research Inst., Republic of Korea; Sung, Bongzoo, Korea Aerospace Research Inst., Republic of Korea; Chang, Keun-Shik, Korea Advanced Inst. of Science and Technology, Republic of Korea; Journal of Aircraft;

Feb. 1998; ISSN 0021-8669; Volume 35, no. 1, pp. 99-105; In English; Copyright; Avail: Aeroplus Dispatch

The flexible wall contour of the new adaptive wall test section is represented as a combination of base streamlines. The combination coefficients are optimized to minimize the wall interference that is taken as the summation of the area weighted surface pressure difference between the free air and test section results. The numerical simulations show that the new adaptive wall test section produces similar results to the free air results. This new algorithm is free from the deficiencies of conventional algorithms such as the dependence on a target line, a pressure hole distribution, and influence coefficients. This new adaptation algorithm may be applied to real tests in which conventional adaptation algorithms fail.

Author (AIAA)

Wind Tunnel Walls; Wind Tunnel Tests; Three Dimensional Flow

19980069538

The Center for Aerodynamic and Thermal Studies of Poitiers (CEAT) - A university research center oriented towards aerospace ***Le Centre d'Etudes Aerodynamiques et Thermiques de Poitiers /CEAT/ - Un centre de recherches universitaire tourne vers l'aerospatial***

Guilbaud, Michel, Poitiers, Univ., France; Nouvelle Revue d'Aeronautique et d'Astronautique; Jun. 1997; ISSN 1247-5793, no. 3, pp. 64-67; In French; Copyright; Avail: Aeroplus Dispatch

This paper gives an overview of the facilities and types of experiments conducted at the Centre d'Etudes Aerodynamiques et Thermiques (CEAT) of the University of Poitiers, France. The CEAT's three major laboratories do work in the fields of fluid mechanics (mainly aerodynamics), heat, and combustion, and are associated with the French Centre National de la Recherche Scientifique (CNRS).

AIAA

Research and Development; Hypervelocity Wind Tunnels; Turbulence; University Program; Aerodynamics; Combustion Physics

19980070122

Measurement of the buckling of models using photogrammetry ***Mesures de deformees de maquettes par photogrammetrie***

Gatard, J., ONERA, France; Gelman, M., Rohr Europe, France; Quinsac, A., Aerospatiale, France; ONERA, TP no. 1997-21; 1997; In French

Report No.(s): ONERA, TP no. 1997-21; Copyright; Avail: Aeroplus Dispatch

A new close range photogrammetry buckling measurement method, proposed by ROHR Europe, has been tested in the ONERA F1 low-speed pressurized wind tunnel with two configurations of an AIRBUS A330/A340 model. In the case of an aluminum one-piece wing, the measured buckling evolved linearly with the aerodynamic load, with a low scattering for each load level. Load-induced twist measurement uncertainty is about 0.02 deg, compared to a maximum twist of about 1 deg. The load-induced vertical displacement uncertainty is about 0.15 mm, compared to a maximum vertical displacement of about 25 to 30 mm. A comparison with finite elements calculations shows good agreement, especially for the twist. In the case of high-lift devices equipped steel wing, the wing central box shows a qualitatively satisfying twist variation, for example for the buckling linearity, as a function of the wing load. At the wing tip, the load induced twist is about 0.6 deg, for a load close to the model maximum use load. For high-lift devices, relative variations of the gaps and overlaps stay under 1 percent for the slats and 1.5 percent for the flaps. It can be concluded that there is no significant displacement of the high-lift devices under the aerodynamic loads encountered in the F1 high Reynolds number wind tunnel. This measurement method has been successfully tested in the F1 low speed pressurized wind tunnel and can be considered for industrial tests in other wind tunnels.

Author (AIAA)

Wind Tunnel Models; Buckling; Photogrammetry; Wing Loading

19980070854

The UK airblast test facility

Taylor, Richard C., ML Lifeguard Equipment, Ltd., UK; 1997, pp. 476-478; In English; Copyright; Avail: Aeroplus Dispatch

The UK Airblast Test Facility was initially developed as a vertical spin wind tunnel, but was converted in the 1960's into a high speed airblast test facility with a maximum equivalent air velocity of Mach 1.1. The test fixture can be rotated, raised or reclined as required. The 30-inch diameter outlet nozzle incorporates a hydraulically controlled platform to deflect the airblast above the item under test until speed stabilization has been established, at which point the deflector drops, sweeping the airblast down over the test item. The airblast can the be configured to decay at a predetermined rate to simulate, for example, the decaying airblast following an aircrew ejection. Having a capacity of 120,000 cu ft, the reservoir only loses approximately 5 percent of its 40 psi. charge pressure for a full 600 knot blast. With compressors and storage vessels to match the scale of the facility, the recharg-

ing time is typically 5 min. Hence, retest times are limited only by the turn around of the equipment under test. Supported by high speed video and cine cameras, the facility offers an excellent, cost-effective development and qualification test facility.
Author (AIAA)
Blast Loads; Test Facilities; Wind Tunnel Tests; High Speed Cameras; Flight Crews; Protectors

19980071102

Synthetic training

Eastment, Dick, UK; Aerospace International; Nov. 1997; ISSN 0305-0831; Volume 24,, no. 11, pp. 18-20, 22; In English; Copyright; Avail: Aeroplus Dispatch

The present evaluation of the state-of-the-art in the use of simulators for initial military flight training argues that this technology is approaching the limits of its development. It is suggested that simulation techniques must expand into war-fighting training, by conducting team training and employing synthetic environments.
AIAA
Flight Simulators; Flight Simulation; Transfer of Training

19980071429

Major structural tests - Forty years of experience at the Toulouse Aeronautical Testing Center (CEAT) ***Les grands essais de structures - 40 ans de pratique au Centre d'Essais Aeronautique de Toulouse /CEAT/***

Sagnol, Jean-Claude, DGA, Centre d'Essais Aeronautique de Toulouse, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Apr. 1997; ISSN 1247-5793, no. 2, pp. 77-83; In French; Copyright; Avail: Aeroplus Dispatch

Full scale airfame tests play a major role in demonstrating the structural resistance required by the Airworthiness Authorities for civil or military aircraft certification. Some of these tests must imperatively be carried out before type certification or even before the first flight; they are then on the critical path in program development. This situation leads to increasingly severe scheduling constraints for the tests. This context means that it is even more true today than in the past that the tester's main target must be to work fast and efficiently while keeping costs as low as possible. This is the challenge that CEAT has taken up, using its 40 years'experience to develop original facilities and methods. The major programs undertaken by the CEAT over the past 40 years which have brought major technological advances are outlined. The early 1990s were a period of intense activity for the CEAT, when it simultaneously undertook the full scale tests for the A330-A340, Rafale, and Falcon 2000 programs, along with other various static or fatigue tests. Certain aspects which are not always fully taken into account during the development process are discussed. They include the safety of the structure under test, the reliability and availability of the test system, and the traceability of the test parameters.
AIAA
Aircraft Structures; Ground Tests

19980071431

Reduction of design and production costs - The role of wind tunnel tests ***Reduction des couts de conception et de production - Role des essais en soufflerie***

Carrara, Jean-Marie, ONERA, Centre du Fauga-Mauzac, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Apr. 1997; ISSN 1247-5793, no. 2, pp. 95-100; In French; Copyright; Avail: Aeroplus Dispatch

Wind tunnel tests, and their close liaison with numerical simulations, permit the validation of new aerodynamic design concepts. This allows the aeronautical industry to develop new projects at minimal risk and cost. The role of wind tunnel tests in program cost reduction is discussed. Examples are cited in the development of the supersonic transport, cruising flight drag reduction, combat aircraft development, and the Apache program cost and delay reduction.
AIAA
Cost Reduction; Wind Tunnel Tests; Digital Simulation; Aerodynamic Characteristics

19980072157

Application of the quaternion in fighter aircraft flight simulation

Xu, Peizhen, Beijing Univ. of Aeronautics and Astronautics, China; Dong, Changhong, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 487-491; In Chinese; Copyright; Avail: Aeroplus Dispatch

The reasons why the quaternion is used in flight simulation of fighter aircraft, and the geometrical meaning of the quaternion, are described according to the axis system used in flight simulation of fighter aircraft in China. Three problems are introduced: (1) quaternion kinematic equations, (2) relationship of the quaternion and coordinate transformation matrices, and (3) Euler angles

in terms of the quaternion. A set of digital simulation curves is given. The advantages of the quaternion method over the Euler method are discussed.
Author (AIAA)
Quaternions; Flight Simulation; Fighter Aircraft

19980072229

Transonic PIV (Particle Image Velocity) measurements made in the stator trailing edge and rotor region of the ILPF (Isentropic Light Piston Facility) at Pyestock Farnborough

Bryanston-Cross, P. J., Warwick, Univ., UK; Burnett, M., Warwick, Univ., UK; Lee, W. K., Warwick, Univ., UK; Udrea, D. D., Warwick, Univ., UK; Chana, K., Defence Evaluation and Research Agency, UK; Anderson, S. J., Defence Evaluation and Research Agency, UK; 1997, pp. 561-574; In English; Copyright; Avail: Aeroplus Dispatch

A series of measurement have been made using PIV in the trailing edge region of the stator row and rotor in the annular transonic cascade at RAE (Royal Aircraft Establishment) Farnborough. The measurements provide an instantaneous quantitative whole field visualization of an unsteady transonic flow interaction region. This work is the first such measurement to be made in a rotating transonic facility.
Author (AIAA)
Particle Image Velocimetry; Transonic Flow; Test Facilities; Gas Turbine Engines

19980072310

Addition of a runway at a major airport can take several years to clear all hurdles

Roenqvist, Robert, Luftfartsverket, Sweden; Jonforsen, Haakan, Luftfartsverket, Sweden; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 5, 6, 25; In English; Copyright; Avail: Aeroplus Dispatch

Sweden’s most important airport needs to expand to accommodate strong traffic growth, but the lengthy and difficult environmental approval process means the construction of a third runway is still in doubt. Plans for the runway and the regulatory hurdles are described.
AIAA
Runways; Airports; Economic Development; Regulations; Air Traffic; Airport Planning

19980072311

Traffic forecasts underscore an urgent need for airport construction and expansion

D’Amato, Barbara, Air Transport Action Group, Switzerland; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 7, 8, 25; In English; Copyright; Avail: Aeroplus Dispatch

The Asia/Pacific region is investing more in airport development than any other world region. Even so, capacity is not expected to keep up with demand. Airport development plans in the individual countries of the region are described here.
AIAA
Air Traffic; Airport Planning; Economic Development; Airports

19980072312

ICAO examining the impact of proposed larger aeroplanes on airport design specifications

Rao, Arun K. R., ICAO, Canada; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 10, 11; In English; Copyright; Avail: Aeroplus Dispatch

Aircraft having wing spans over 65 m and outer main gear more than 14 m apart may enter commercial service as early as 2003. In preparation, aerodrome experts are evaluating possible changes in the specifications related to the design of runways, taxiways, and aprons.
Author (AIAA)
Organizations; Civil Aviation; International Cooperation; Airport Planning; Specifications

19980072313

Future test facility will advance the state of airport pavement design

Agrawal, Satish K., FAA, USA; ICAO Journal; Sep. 1997; ISSN 0018-8778; Volume 52, no. 7, pp. 12, 13, 25; In English; Copyright; Avail: Aeroplus Dispatch

Government and industry are working to develop new procedures capable of providing pavement thickness designs for all aircraft weight and landing gear configurations which might come into operation in the foreseeable future. Current pavement testing capabilities at Tyndall Air Force Base in the United States and at Progresstech Ltd. in the Russian Federation are described.
AIAA
Test Facilities; Airport Planning; Pavements

19980072457
Airport technology international 1998
1997; In English
Report No.(s): ISSN 0951-9688; Copyright; Avail: Aeroplus Dispatch

Various papers on airport technology are presented. The topics addressed include: airport technology for the next century, Bordeaux Terminal B, B-777 asphalt pavement design, quality services on the ground, sensible integration of apron systems, choosing the best explosive detection system, walk-through explosive detector tightens the net on terrorists, contraband detection, Malpensa airport, escalators at airport increase passenger comfort, Bordeaux passenger mobility, automation in China's growing aviation industry, and current Harris Corporation programs in airport integration. Also discussed are: ShearAlert low-level windshear alert system, rapid growth in Chinese air traffic, air traffic control at Bordeaux, invisible terminal manager, Melbourne airport baggage update, Year of the Panther, Swissport ground handling, safety spurs faster turnaround on the apron, China ready for international competition, China harnesses Western airliner technology, improving glass safety in airport facilities, and getting the FRA handling advantage.
AIAA
Conferences; Airports; Research and Development

19980072458
Sensible integration of apron systems
Tupack, Robert, INET Airport Systems, USA; Airport technology international 1998; 1997, pp. 19, 20; In English; Copyright; Avail: Aeroplus Dispatch

The airline industry's first truly integrated airport bridges have recently been installed. This article briefly discusses the design and contracting procedures for achieving an integrated gate system and the total gate management approach used to operate them.
AIAA
Systems Integration; Airports; Systems Engineering

19980072460
Automation in China's growing aviation industry
Airport technology international 1998; 1997, pp. 43, 44; In English; Copyright; Avail: Aeroplus Dispatch

This article describes how Unisys is helping a number of Chinese airports make the transition from primarily manual-based functions to automated systems. The need for the most modern technologies at Chinese airports is emphasized.
AIAA
Automation; China; Aircraft Industry; Airport Planning

19980072464
Safety spurs faster turnaround on the apron
Coops, John, UK; Airport technology international 1998; 1997, pp. 83, 84; In English; Copyright; Avail: Aeroplus Dispatch

In this article, the technical manager for an aircraft refuelling company outlines some parameters for developing safe and swift aircraft turnaround techniques on airport aprons. The actions that need to be taken to refuel an aircraft during turnaround are addressed.
AIAA
Flight Safety; Aeronautics; Refueling

19980072595
Naval aviation strategy for depainting
Barilia, Mark, U.S. Navy, Naval Air Warfare Center, USA; Barnes, Rick, U.S. Navy, Naval Air Warfare Center, USA; Game, Cliff, U.S. Navy, Naval Air Warfare Center, USA; Hartle, Steve, U.S. Navy, Naval Air Warfare Center, USA; McKinley, Darrell,, U.S. Navy, Naval Air Warfare Center, USA; Meno, Mark, U.S. Navy, Naval Air Warfare Center, USA; Whitfield, James, U.S. Navy, Naval Air Warfare Center, USA; Woods, Tim, U.S. Navy, Naval Air Warfare Center, USA; Aerospace Engineering; Dec. 1997;

ISSN 0736-2536; Volume 17,, no. 12, pp. 24, 25; In English; Copyright; Avail: Aeroplus Dispatch

Naval Air Systems (NAVAIR) has been vigorously pursuing the elimination of methylene chloride-based paint removal technology for several years. A result of this effort is a cohesive strategy addressing both short-term and long-term paint removal practices within its depots. The plan accommodates environmental issues, current and developing technologies, and facilities requirements. The variety of Navy facilities means several environmentally friendly depainting processes must replace a single traditional process. The goal of NAVAIR is to implement these paint removal process changes with minimum impact on production, cost, and product quality. The requirements and considerations to be taken into account in implementing the depainting strategy are detailed in this article.

AIAA

Aircraft Performance; Technology Assessment; Aircraft Maintenance; Technological Forecasting; Paint Removal

19980073005

A magnetic suspension and excitation system for spin vibration testing of turbomachinery blades

Johnson, Dexter, NASA Lewis Research Center, USA; Brown, Gerald V., NASA Lewis Research Center, USA; Mehmed, Oral, NASA Lewis Research Center, USA; Apr. 1998; In English

Report No.(s): AIAA Paper 98-1851; Copyright; Avail: AIAA Dispatch

The Dynamic Spin Rig (DSR) is used to perform vibration tests of turbomachinery blades and components under spinning conditions in a vacuum. A heteropolar radial active magnetic bearing was integrated into the DSR to provide noncontact magnetic suspension and mechanical excitation of the rotor to induce turbomachinery blade vibrations. The magnetic bearing replaces one of the two existing conventional radial ball bearings. Prior operation of the DSR used two voice-coil type linear EM shakers which provided axial excitation of the rotor. The new magnetic suspension and excitation system has provided enhanced testing capabilities. Tests were performed at high rotational speeds for longer duration and with higher vibration amplitudes. Some characteristics of the system include magnetic bearing stiffness values up to 60,000 lb/in., closed loop control bandwidth around 500 Hz, and multidirectional radial excitation of the rotor. This paper reports on the implementation and operation of this system and presents some test results using this system.

Author (AIAA)

Turbine Blades; Vibration Tests; Magnetic Bearings; Spin Dynamics; Magnetic Suspension; Vibration Damping

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19980049290

Optimal aerocapture with minimum total heat load

Sigal, E., Technion - Israel Inst. of Technology, Haifa, Israel; Guelman, M., Technion - Israel Inst. of Technology, Haifa; 1998, pp. 331-337; In English; Copyright; Avail: Aeroplus Dispatch

The purpose of this work is to find optimal trajectories for spacecraft aerocapture while minimizing the total heat load on the body during the atmospheric phase. The bank angle is employed as the control such that only the side of the spacecraft facing the flow is to be thermally protected. In solving the problem, it is assumed that the angle of attack is constant. Final time as well as the final orbital plane of motion are free. Final boundary conditions for aerocapture are the final orbital semimajor axis and eccentricity. The optimal solution gives two types of trajectories: (1) a planar trajectory with the bank angle shown to be of the bang-bang type, and (2) trajectories containing a singular arc, flown at a constant altitude and at a variable bank angle, resulting in a change of the orbital plane. Numerical results are presented for the case of planar (nonsingular) aerocapture.

Author (AIAA)

Aerocapture; Spacecraft Trajectories; Trajectory Optimization; Atmospheric Entry; Aerodynamic Heat Transfer; Thermal Protection

19980049520

Synthesis of contributions to the Electre in F4 test case TC1.b within the Manned Space Transportation Program Workshop 1996 reentry aerothermodynamics and ground-to-flight extrapolation held at ESA/ESTEC, Noordwijk, the Netherlands, March 25-27, 199

Sagnier, Philippe, ONERA, France; Borrelli, Salvatore, CIRA, Italy; ONERA, TP no. 1997-84; 1997; In English
Report No.(s): ONERA, TP no. 1997-84; Copyright; Avail: Aeroplus Dispatch

F4 high enthalpy wind tunnel experiments were carried out for the Electre configuration, which has been selected as a test case for the Manned Space Transportation Program Workshop 1996 held at ESTEC. Experimental results, including schlieren, wall pressure, and heat flux at moderate total conditions are synthesized in this paper as computed by five contributors from CIRA, DLR, ESTEC, ONERA, and the University of Provence, France.
AIAA
F-4 Aircraft; Manned Space Flight; Aerothermodynamics; Reentry Physics

19980050121

Dynamics and control of an atmospheric tether with a lifting probe

Biswell, Brian L., Arizona State Univ., Tempe, USA; Puig-Suari, Jordi, Arizona State Univ., Tempe; 1997, pp. 45-59; In English
Report No.(s): AAS Paper 97-602; Copyright; Avail: Aeroplus Dispatch

This paper explores the dynamics and control of an atmospheric tether system using a lifting probe with a movable attachment point. The dynamics of the system are linearized about equilibria for circular equatorial orbits. Examination of the eigenvalues of the linearized system shows that there is always at least one unstable mode that needs to be controlled. Using the attachment point motion and thrust, the system is controllable for the conditions considered. A linear controller is designed for the system with a rigid tether. The same controller is then applied to a flexible-elastic tether system to examine robustness.
Author (AIAA)
Tethered Satellites; Satellite Control; Systems Stability; Probes; Lift

19980050576

Autonomous modal identification of the Space Shuttle tail rudder

Pappa, Richard S., NASA Langley Research Center, USA; James, George H., III, Houston, Univ., USA; Zimmerman, David C., Houston, Univ., USA; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 163-169; In English; Copyright; Avail: Aeroplus Dispatch

Autonomous modal identification automates the calculation from experimental data of natural vibration frequencies, damping, and mode shapes of a structure. This technology complements damage detection techniques that use continuous or periodic monitoring of vibration characteristics. The approach incorporates the Eigensystem Realization Algorithm as a data analysis engine and an autonomous supervisor to condense multiple estimates of modal parameters using the consistent-mode indicator and correlation of mode shapes. The procedure was applied to free-decay responses of a Space Shuttle tail rudder and successfully identified the first seven vibration modes of the structure. The final modal parameters are a condensed set of results for 87 individual cases requiring approximately five min of computer time on a UNIX workstation.
Author (AIAA)
Modal Response; Space Shuttles; Rudders; Tail Assemblies; Vibration Measurement

19980050888

Panoramic modal testing of the Space Shuttle Main Engine alternative turbopump inlet bellows liner

Lindner, J. L., NASA Marshall Space Flight Center, USA; Gilbert, J. A., Alabama, Univ., Huntsville; Experimental Techniques; Apr. 1998; ISSN 0732-8818; Volume 22, no. 2, pp. 15-19; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the first practical application of a unique approach to modal analysis in which time-average holograms are recorded through a panoramic system. When inserted into a cylindrical structure, the system allows a relatively large portion of the surroundings to be illuminated and observed. The approach is applied to study the modal response of a turbopump liner designed for use in the Space Shuttle Main Engine.
AIAA
Space Shuttle Main Engine; Turbine Pumps; Engine Inlets; Linings; Bellows; Holographic Interferometry; Vibration Tests; Modal Response

19980051035

Small aircraft as a tool for space applications education

Oprisiu, C., National Inst. for Aerospace Research, Romania; Piso, M. I., Romanian Space Agency, Romania; Prunariu, D. D., Romanian Space Agency, Romania; Advances in Space Research; Oct. 1997; ISSN 0273-1177; Volume 20, no. 7, pp. 1361-1364; In English; Copyright; Avail: Aeroplus Dispatch

A small unmanned aircraft, a lenticular aerodyne, was developed for experimentation and for teaching a class on space science and technology applications. The vehicle is equipped for training in remote sensing, communications, attitude control, and navigation. The small aircraft system is a model of a complete space mission with the space and ground segments providing the basic functions. Rapid validation and consideration of ground truth parameters is also possible. The main advantage of this system is the reduced period of time necessary to understand and to adjust the phases of a mission, with low costs.

AIAA

Aerospace Sciences; Education; Pilotless Aircraft

19980051352

Evaluation of GPS/IMU trajectory estimation performance for realtime missile flight safety

McConnell, John, USAF, USA; Greenberg, Robert, USAF, USA; Brooks, Richard A., ITT Federal Services Corp., USA; Hsieh, John, ITT Federal Services Corp., USA; Grimes, Fred; 1997, pp. 1119-1134; In English

Report No.(s): AAS Paper 97-673; Copyright; Avail: Aeroplus Dispatch

The application of maturing technologies such as GPS and strapdown inertial navigation to the problems of flight safety for ballistic missiles and spacelift vehicles is of growing interest at the Eastern and Western Ranges operated by the USAF Space Command. An area of particular interest is the integration of GPS user equipment and onboard inertial measurement units (IMU) to exploit the synergism between these two technologies and achieve enhanced metric accuracy for realtime tracking and instantaneous impact prediction. The study reported herein examines a GPS/IMU integration mechanization which typifies that which would be expected in practice for realtime ballistic missile and spacelift vehicle applications. The performance of this mechanization is evaluated for the major classes of vehicles launched from the two ranges. The results of this performance evaluation show clearly for all classes of vehicles and trajectories that the integrated mechanization provides superior accuracy to either a standalone GPS or IMU. A result of some significance is that an IMU of moderate accuracy augmented with only a relatively small quantity of GPS data can satisfy all realtime flight safety metric accuracy requirements.

Author (AIAA)

Global Positioning System; Missile Trajectories; Flight Safety; Real Time Operation; Strapdown Inertial Guidance; Inertial Platforms

19980051694

New economic structures for space in the 1980s

Heiss, Klaus P., Econ, Inc., USA; Structures technology - Historical perspective and evolution; 1998, pp. 399-402; In English; Copyright; Avail: Aeroplus Dispatch

It is argued that new goals, programs, and economic structures are needed to make maximum use of the opportunities in space. It is suggested that NASA's goal for the 1980 should be establishing a strong technological presence in a geosynchronous orbit by 1990. Space transportation services should be moved from NASA and other government agencies to a Space Transportation Company for operating and marketing any such services now performed by the government. Space applications and technology utilization funding should be transferred from NASA to a Space Bank, to be funded over the next decade and to become self-supporting at a later date.

AIAA

Research and Development; Astronautics; Aeronautics

19980051697

Developing HST structural technology

Laidlaw, W. R., North American Aviation, Inc., USA; Johnston, E. W., North American Aviation, Inc., USA; Structures technology - Historical perspective and evolution; 1998, pp. 367-372; In English; Copyright; Avail: Aeroplus Dispatch

Two general categories of hypersonic transport (HST) concepts are examined. The first has a nominal cruising speed of Mach 6. The main structural components are for the crew, 150 passengers, fuel compartments, wing, empennage surfaces, and a subsonic combustion turboramjet propulsion system. The concept described would employ methane fuel and would be about 300 ft long. A similar comfiguration employing liquid hydrogen fuel would have a larger fuel volume. The second concept, which has a Mach-12 cruising speed, requires a very high level of integration for the inlet (forward fuselage), inlet-dowl-combustion section,

exhaust nozzle (aft fuselage), liquid hydrogen tankage, and passenger (150) compartments. The vehicle would be about 200 ft long and have a much wider fuselage. The discussion covers structural temperatures, materials, aerothermoelasticity considerations, and structural testing.
AIAA
Hypersonic Vehicles; Structural Design; Aerothermoelasticity; Aerospace Planes

19980051912
Upgrading of an arc-heated flow facility for re-entry simulation
Esposito, A., Napoli Federico II, Univ., Italy; Monti, R., Napoli Federico II, Univ., Italy; Russo, G. P., Napoli Federico II, Univ., Italy; Savino, R., Napoli Federico II, Univ., Italy; Ferrigno, F., Napoli Federico II, Univ., Italy; 1997, pp. 491-500; In English; Copyright; Avail: Aeroplus Dispatch

The High Enthalpy Blow-Down Arc Facility (HEBDAF) at the Department of Space Sciences and Engineering in Naples, originally built for experimental and theoretical studies in the plasma diagnostic field, has been modified as an atmospheric reentry simulator to simulate the heat fluxes experienced along the reentry path by a space vehicle. Upgrading of the facility was necessary to accommodate higher mass flow rates with the existing vacuum pumps. For this purpose a fixed throat diffuser with different L/D ratios for providing the highest pressure recovery is studied.
Author (AIAA)
Spacecraft Reentry; Atmospheric Entry Simulation; Blowdown Wind Tunnels; Arc Heating

19980052219
Stability analysis of optimal three-dimensional hypersonic skip trajectories
de-Olive Ferreira, L., INPE, Brazil; Prado, A. F. B. A., INPE, Brazil; Vinh, N. X., Michigan, Univ., Ann Arbor; 1997, pp. 867-886; In English
Report No.(s): AAS Paper 97-656; Copyright; Avail: Aeroplus Dispatch

An analytical theory for the highly unsteady, strongly nonlinear, geometrically complex problem of the stability of optimal 3D, non-thrusting, single-pass skip maneuvers is introduced. Under Eggers's classical hypothesis, and assuming a shallow entry, we start out by solving a final-speed maximization problem. This yields explicit optimal control laws. The resulting trajectory is then adopted as a reference to which regular perturbations are applied, with the corresponding equations being subsequently nondimensionalized. Stability of the system thus obtained is assessed via application of Liapunov's first theorem. However, given the unsteady nature of the nominal trajectory, Vinogradov's apparent paradox is shown to greatly complicate the analysis. A set of accurate analytic solutions for 3D skips is also presented.
Author (AIAA)
Systems Stability; Trajectory Optimization; Hypersonic Flight; Flight Paths; Optimal Control

19980052265
Flight control, dynamics, and structural interaction on the second Hubble Space Telescope servicing mission
Sackett, Lester L., Charles Stark Draper Lab., Inc., USA; Kirchwey, Christopher B., Charles Stark Draper Lab., Inc., USA; Johnson, Michael C., Charles Stark Draper Lab., Inc., USA; Barrington, Ray D., NASA Johnson Space Center, USA; 1997, pp. 2015-2034; In English
Contract(s)/Grant(s): NAS9-19556
Report No.(s): AAS Paper 97-730; Copyright; Avail: Aeroplus Dispatch

The second Hubble Space Telescope (HST) Servicing Mission (SM) occurred in February 1997 on STS-82. Throughout the servicing, the fragile Hubble solar arrays were deployed and loads on the solar arrays caused by the Space Shuttle control jet firings were of great concern. Extensive preflight analyses of possible solar array loads and deflections were performed and flight control system constraints and operational procedures were recommended to mitigate the effect of jet firings. Because of the concern about using the large primary shuttle jets for a reboost maneuver, a scheme was developed to use the smaller vernier jets to perform orbit raising maneuvers. Flight control system stability with a large flexible payload was also considered.
Author (AIAA)
Space Shuttle Missions; Hubble Space Telescope; Flight Control; Solar Arrays; Preflight Analysis

19980052522
Thermal protection of space vehicles
Glaser, Peter E., Arthur D. Little, Inc., USA; Structures technology - Historical perspective and evolution; 1998, pp. 283-288; In English; Copyright; Avail: Aeroplus Dispatch

The general factors to be considered in the design of the thermal protection system of space vehicles are briefly examined. In particular, attention is given to the various heating conditions encountered during a space flight and different thermal protection concepts and approaches to the thermal protection system design. The discussion also covers thermal protection systems for cryogenic fluids, the attainment of a high vacuum in the insulated space, and thermal protection system requirements for manned and instrumented space vehicles and space stations.
AIAA
Thermal Protection; Spacecraft; Aerodynamic Heating; Reentry; Cryogenic Fluid Storage

19980055580
High L/D Mars aerocapture for 2001, 2003 and 2005 mission opportunities
Jits, Roman Y., North Carolina State Univ., Raleigh, USA; Walberg, Gerald D., North Carolina State Univ., Raleigh; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0299; Copyright; Avail: Aeroplus Dispatch
The scope of the present investigation includes realistic trajectory simulations for a biconic aerocapture vehicle with an L/D of 0.78, determination of its entry corridor, design of its nominal entry trajectory, evaluation of its tolerance to atmospheric density variations encountered during aerocapture, and the change in propellant usage resulting from these dispersions. to make the simulation more realistic, minimum Earth capture energy mission opportunities for the years 2001, 2003 and 2005 are chosen for consideration and their results are compared. Arrival dates, entry velocities and geographical entry locations for these mission opportunities are used as entry conditions. In addition, comparative trajectory analysis between a biconic vehicle (L/D = 0.78) and a Viking type vehicle (L/D = 0.18) are carried out for the 2005 mission. The 2005 opportunity is a likely candidate for a Mars Sample Return Mission, which could benefit significantly from aerocapture.
Author (AIAA)
Mars Sample Return Missions; Aerocapture; Lift Drag Ratio; Trajectory Planning; Mars Atmosphere; Aerobraking

19980055581
Launch vehicle dynamic stability characteristics with designed flight control augmentors
Barret, C., NASA Marshall Space Flight Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0300; Copyright; Avail: Aeroplus Dispatch
This paper is the third in a three-part series that presents the results of a comprehensive research project which has proposed to provide flight control augmentation for an aft center-of-gravity (CG) launch vehicle (LV) that could not be adequately controlled by engine gimbaling alone. This paper presents the dynamic stability wind tunnel test program conducted at MSFC, the dynamic stability characteristics of the experimental LV with the designed flight control augmentors, and a consideration of the elastic vehicle.
Author (AIAA)
Launch Vehicles; Dynamic Stability; Flight Control; Control Systems Design; Wind Tunnel Tests; Stability Augmentation

19980055582
ALFLEX flight simulation analysis and flight testing
Motoda, Toshikazu, National Aerospace Lab., Japan; Miyazawa, Yoshikazu, National Aerospace Lab., Japan; Ishikawa, Kazutoshi, National Aerospace Lab., Japan; Izumi, Tatsushi, NASDA, Japan; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0301; Copyright; Avail: Aeroplus Dispatch
The Automatic Landing Flight Experiment (ALFLEX) was conducted in Woomera, Australia, in 1996 in order to develop the automatic landing technology required for the future Japanese unmanned spacecraft, HOPE. In order to ensure successful landings, computer simulation played an important role in the preflight analysis. Monte Carlo Simulation was applied for the analysis. The root sum square (RSS) method, which is commonly used in Japanese launcher rocket development projects, was also applied. Monte Carlo results were compared with the RSS results and the flight test results. All 13 flight tests were successfully completed. Longitudinal guidance in the flare phase was found to be sensitive to some modeling-errors. The cause is discussed.
Author (AIAA)
Unmanned Spacecraft; Spacecraft Landing; Flight Tests; Flight Simulation; Preflight Analysis; Spacecraft Guidance

19980055585
Conceptual design of the LE-7-based reusable launch systems
Nakajima, Masumi, Tohoku Univ., Japan; Mizobata, Kazuhide, Tohoku Univ., Japan; Sawada, Keisuke, Tohoku Univ., Japan; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0304; Copyright; Avail: Aeroplus Dispatch

Unmanned, partly reusable launch systems using reuse-modified LE-7 engines for the first stage, with other near-term technology, are here designed conceptually. Four options are considered: (1) an all-rocket, two-stage system in which the rocket-powered second stage is expended, (2) an all-rocket, two-stage system in which the first stage flies back to the launch site and the rocket-powered second stage is expended, (3) a rocket-scramjet combination three-stage system in which both the second stage using a scramjet engine and the rocket-powered third stage are expended, and (4) a rocket-scramjet combination three-stage system in which the reusable second stage uses a scramjet engine and the rocket-powered third stage is expended. The assumed mission is to deliver a 1 ton payload to LEO inclined at 52 deg. The aerodynamic characteristics and weight estimates are made using existing methods. It is found that the use of scramjet engines in the second stage does not improve performance. Option 1 has the best performance, but Option 2 is more flexible. Performance of Option 2 depends mainly on the lift/drag ratio of the first stage in the subsonic speed range.

Author (AIAA)

Reusable Launch Vehicles; Spacecraft Design; Japanese Spacecraft; Rocket Engines; Aerodynamic Characteristics

19980055652

Meteoroid and orbital debris flight experiment DTO 1118

Winfield, Darrell, Boeing Space and Missile Systems Sector, USA; Graves, Russell, Boeing Space and Missile Systems Sector, USA; Theall, Jeffrey R., NASA Johnson Space Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0390; Copyright; Avail: Aeroplus Dispatch

This paper gives a short overview of the Russian MIR Space Program, examines damage to the Russian space station MIR, including the recent damage incurred because of the progress collision, and explains how this damage assessment will help in planning and risk reduction for the ISS mission. The ISS program is sponsoring this photography and damage assessment of the Russian spacecraft MIR. Space Shuttle Detailed Test Objective (DTO) 1118 is a photographic and video survey of the exterior of MIR to assess damage to the craft from the LEO environment. The primary concern is with the damage associated with Meteoroid and Orbital Debris (M/OD) impacts. The ISS program developed an approach to mitigate risk from M/OD. Management of these risks involves three principles: (1) design to prevent M/OD impacts from penetrating critical hardware by use of state-of-the-art shielding techniques; (2) use radar tracking to complete collision avoidance maneuvers; and (3) minimize residual risk by implementing risk control and abatement procedures. This damage assessment of MIR is part of the overall strategic plan to identify risk and mitigate that risk to the best ability of the program.

Author (AIAA)

Space Debris; Spacecraft Shielding; Meteoritic Damage; Spacecraft Orbits; Flight Safety; International Space Station

19980056061

Surface heating effects of X-33 vehicle TPS panel bowing, steps, and gaps

Palmer, Grant, NASA Ames Research Center, USA; Kontinos, Dean, Thermosciences Inst., USA; Sherman, Brian, BFGoodrich Co., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS2-14031; NCC8-115

Report No.(s): AIAA Paper 98-0865; Copyright; Avail: Aeroplus Dispatch

The thermal protection system on the windward side of the Lockheed-Martin X-33 technology demonstrator vehicle consists largely of metallic panels. As the vehicle travels through the Earth’s atmosphere at hypersonic speeds, thermal gradients between the top and bottom face sheets cause the metallic panels to bow. Steps and gaps will exist at the panel-panel and panel-nosecap interfaces. This study uses Navier-Stokes flow analysis to assess the effects of bowing, steps, and gaps on the surface heating of the vehicle. Analysis is performed at the peak heating, peak Mach, Mach 10 turbulent, and peak negative bowing locations of the nominal Malmstrom 4 trajectory. A series of surface heating augmentation factors are presented that provide the increase or decrease in heating rate as a function of bow height, step height, and gap width. The existence of reverse flow at the panel interfaces due to panel bowing is demonstrated.

Author (AIAA)

X-33 Reusable Launch Vehicle; Metal Surfaces; Temperature Effects; Thermal Protection; Single Stage to Orbit Vehicles; Aerodynamic Heating

19980056062

Numerical simulation of metallic TPS panel bowing

Kontinos, Dean A., Thermosciences Inst., USA; Palmer, Grant, NASA Ames Research Center, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS2-14031; NCC8-115

Report No.(s): AIAA Paper 98-0866; Copyright; Avail: Aeroplus Dispatch

Numerical simulation of the thermoelastic response of metallic thermal protection panels is presented. The panels, which are being designed for use on the windward surface of the X-33 flight test vehicle, deform into convex and concave bowed surfaces due to thermal gradients caused by aerodynamic heating. Three numerical models, one for the flow field, one for the in-depth heat transfer, and one for the thermoelastic deformation, are coupled in sequence to yield the transient response of the metallic panel. The aerothermal loads are derived from CFD solutions and are prescribed as a distribution function with maximum bow height as the governing parameter. Finite element models are used to simulate the thermal and structural response. The coupled simulation is compared to a single pass uncoupled solution. Results show negligible feedback between the structural deformation and the deformation-induced perturbation of the aerothermal heat load. Yet, significant temperature variations on the surface of the panel are produced. The deformations induce lateral temperature gradients that increase the thermal stress within the panel. It is shown that panel bowing does not appreciably alter the trajectory integrated heat load.

Author (AIAA)

X-33 Reusable Launch Vehicle; Metal Surfaces; Thermoelasticity; Thermal Protection; Spacecraft Design; Aerodynamic Heating

19980056064

X-33 aerothermal environment simulations and aerothermodynamic design

Prabhu, Dinesh K., Thermosciences Inst., USA; Loomis, Mark P., NASA Ames Research Center, USA; Venkatapathy, Ethiraj, Thermosciences Inst., USA; Polsky, Susan, Thermosciences Inst., USA; Papadopoulos, Perklis, Thermosciences Inst., USA; Davies, Carol B., Sterling Software, Inc., USA; Henline, William D., NASA Ames Research Center, USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS2-14301; NCC8-115

Report No.(s): AIAA Paper 98-0868; Copyright; Avail: Aeroplus Dispatch

The computed high-fidelity hypersonic aerothermal acreage environments (surface pressures, radiative equilibrium surface temperatures, surface streamlines), used in conjunction with an engineering method to define and design the Thermal Protection System (TPS) for the X-33 flight vehicle, are presented. The environments are computed in two paradigms - (1) a trajectory paradigm in which flow-field solutions are computed at a number of points along design trajectories, and (2) a design space paradigm in which solutions are computed at several points in a space, parameterized by the freestream Mach number, angle of attack, and Reynolds number, independent of a flight trajectory. Further, the aerothermal environments for deflected control surfaces (on both the canted and vertical fins) and the effect of yaw are presented. The impact of configuration changes, an evolutionary process unavoidable in design, is also studied.

Author (AIAA)

X-33 Reusable Launch Vehicle; Aerothermodynamics; Hypersonic Speed; Pressure; Surface Temperature; Thermal Protection

19980056065

Computational/experimental aeroheating predictions for X-33 Phase II vehicle

Hamilton, Harris H., II, NASA Langley Research Center, USA; Weilmuenster, K. J., NASA Langley Research Center, USA; Horvath, Thomas J., NASA Langley Research Center, USA; Berry, Scott A., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0869; Copyright; Avail: Aeroplus Dispatch

Laminar and turbulent heating-rate calculations from an ’engineering’ code and laminar calculations from a ’benchmark’ Navier-Stokes code are compared with experimental wind-tunnel data obtained on several candidate configurations for the X-33 Phase II flight vehicle. The experimental data were obtained at a Mach number of 6 and a freestream Reynolds number ranging from 1 to 8 x 10 exp 6/ft. Comparisons are presented along the windward symmetry plane and in a circumferential direction around the body at several axial stations at angles of attack from 20 to 40 deg. The experimental results include both laminar and turbulent flow. For the highest angle of attack some of the measured heating data exhibited a ’nonlaminar’ behavior which caused the heating to increase above the laminar level long before ’classical’ transition to turbulent flow was observed. This trend was not observed at the lower angles of attack. When the flow was laminar, both codes predicted the heating along the windward symmetry plane reasonably well but under-predicted the heating in the chine region. When the flow was turbulent the LATCH code accurately predicted the measured heating rates. Both codes were used to calculate heating rates over the X-33 vehicle at the peak heating point on the design trajectory, and they were found to be in very good agreement over most of the vehicle windward surface.

Author (AIAA)

Aerodynamic Heating; X-33 Reusable Launch Vehicle; Laminar Flow; Navier-Stokes Equation; Heat Transfer; Turbulent Flow

19980056066

Development of an aerothermodynamic environments database for the integrated design of the X-33 prototype flight test vehicle

Bowles, Jeffrey V., NASA Ames Research Center, USA; Henline, William D., NASA Ames Research Center, USA; Hyunh, Loc C., ThermoSciences Inst., USA; Davies, Carol B., Sterling Software, Inc., USA; Roberts, Cathy D., Sterling Software, Inc., USA; Yang, Lily H., Sterling Software, Inc., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS2-13210; NCC8-115

Report No.(s): AIAA Paper 98-0870; Copyright; Avail: Aeroplus Dispatch

The methodology and selected results of the X-33 effort to provide a complete, high-fidelity aerothermodynamic design data base needed for the final thermal protection system design are presented. The approach taken here is based on the requirements for hypersonic vehicle systems analysis and optimization as embodied in the NASA vehicle synthesis code HAVOC. Justification for this approach lies in the presumption that the aerothermodynamic heating data required by a synthesis code such as HAVOC to perform vehicle shape, size, weight, performance, and cost optimization constrained to a given mission trajectory are the same data-base requirements needed to perform a final vehicle detailed design. For the case of the X-33, this requirement is fulfilled through the construction of a comprehensive aero-heating data base covering a range of Mach numbers, angles-of-attack and dynamic pressure appropriate to the X-33 flight envelope. New data-base interpolation tools were developed to upgrade the resident engineering level aero-heating methods in HAVOC to completely span the flight envelope while intersecting the CFD generated data-base entries or 'anchor points'. A description of each of these new tool developments is provided in the paper, together with some selected computational results for the heating environment experienced by the X-33.

Author (AIAA)

Aerothermodynamics; Data Bases; X-33 Reusable Launch Vehicle; Flight Tests

19980056074

Computational aeroheating predictions for X-34

Kleb, William L., NASA Langley Research Center, USA; Wood, William A., NASA Langley Research Center, USA; Gnoffo, Peter A., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0879; Copyright; Avail: Aeroplus Dispatch

Radiative equilibrium surface temperatures, heating rates, streamlines, surface pressures, and flow-field features as predicted by the Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA) are presented for the X-34 Technology Demonstrator. Results for two trajectory points corresponding to entry peak heating and two control surface deflections are discussed. This data are also discussed in the context of Thermal Protection System (TPS) design issues. The work presented in this report is part of a larger effort to define the X-34 aerothermal environment, including the application of engineering codes and wind-tunnel studies.

Author (AIAA)

Aerothermodynamics; Aerodynamic Heating; Pressure; Wind Tunnel Tests; Heating

19980056076

X-34 experimental aeroheating at Mach 6 and 10

Berry, Scott A., NASA Langley Research Center, USA; Horvath, Thomas J., NASA Langley Research Center, USA; DiFulvio, Michael, NASA Langley Research Center, USA; Glass, Christopher, NASA Langley Research Center, USA; Merski, N. R., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0881; Copyright; Avail: Aeroplus Dispatch

This report provides an overview of the hypersonic aeroheating wind tunnel test program conducted at NASA/Langley in support of the X-34 small reusable technology demonstrator program. Global surface heat transfer images, surface streamline patterns, and shock shapes were measured on 0.0153- and 0.0183-scale models of proposed X-34 flight vehicles at Mach 6 and 10 in air. The primary parametrics that were investigated include angles-of-attack from 0 to 35 deg and freestream unit Reynolds numbers from 0.5 to 8 million per foot (which was sufficient to produce laminar, transitional, and turbulent heating data), both with and without control surface deflections. Comparisons of the experimental data to computational predictions are included, along with a discussion of the implications of some of the experimental flow features for the flight vehicle.

Author (AIAA)

X-34 Reusable Launch Vehicle; Aerodynamic Heating; Mach Number; Wind Tunnel Tests; Aerothermodynamics; Hypersonic Wind Tunnels

19980056077

Engineering aerothermal analysis for X-34 thermal protection design

Wurster, Kathryn E., NASA Langley Research Center, USA; Riley, Christopher J., NASA Langley Research Center, USA; Zoby, E. V., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0882; Copyright; Avail: Aeroplus Dispatch

The process used to generate the aerothermal environments required for the X34 Testbed Technology Demonstrator thermal protection system design is described as it has evolved from a relatively simplistic approach based on engineering methods applied to critical areas to one of detailed analyses over the entire vehicle. A brief description of the trajectory development leading to the selection of the thermal protection system design trajectory is included. Comparisons of engineering heating predictions with wind-tunnel test data and with results obtained using a Navier-Stokes flow-field code and an inviscid/boundary layer method are shown. Good agreement is demonstrated among all these methods for both the ground-test condition and the peak heating flight condition. Finally, the detailed analysis using engineering methods to interpolate the surface-heating-rate results from the inviscid/ boundary layer method to predict the required thermal environments is described and results presented.

Author (AIAA)

X-34 Reusable Launch Vehicle; Thermal Protection; Hypersonic Flight; Navier-Stokes Equation; Wind Tunnel Tests; Aerothermodynamics

19980057807

Aviation's next great leap

Zubrin, Robert, USA; Clapp, Mitchell B.; Technology Review; Feb. 1998; ISSN 0040-1692; Volume 10, no. 9, pp. 30-36; In English; Copyright; Avail: Aeroplus Dispatch

The availability of reliable reusable rocket engines could make possible the next major step in aerospace transportation, the rocketplane. Rocketplanes combine rocket propulsion with aviation, allowing aircraft that take off and land from conventional airports to fly up and out of the atmosphere. Rocketplanes will lower the cost of satellite launch, accelerate the delivery of packages, and, ultimately, provide a way for people to travel from one side of the world to the other in an hour or so.

AIAA

Hypersonic Aircraft; Rocket Engines; Aeronautics

19980058187

Measurement and evaluation of radiation dose distribution of gamma-ray altimeter in static test for recovery capsule during simulated landing

Song, Jinghe, China Inst. of Atomic Energy, Beijing, China; Shi, Yongqian, China Inst. of Atomic Energy, Beijing; Lin, Shenghuo, China Inst. of Atomic Energy, Beijing; Dong, Shijie, China Inst. of Atomic Energy, Beijing; Zhang, Zhigang, China Inst. of Atomic Energy, Beijing; Shen, Zuwei, China Inst. of Atomic Energy, Beijing; Space Medicine & Medical Engineering; Oct. 1997; ISSN 1002-0837; Volume 10, no. 5, pp. 363-366; In Chinese; Copyright; Avail: Aeroplus Dispatch

The gamma-ray altimeter, containing a gamma-radioactive source Cs-37 with activity of 2.96 x 10 exp 10 Bq, was used to detect the height of a spacecraft recovery capsule during landing. to measure the gamma-dose distribution near the guidance section, especially at a position where the useful load is located in the recovery capsule, a gamma-dose field at the test site for one machine test was measured by means of a gamma-dose rate meter FJ-317C and a gamma-dose meter ANRI-01-02. The results showed that the absorbed dose rate at 5 m from the gamma source on the ground is as low as the radiation protection limit when the altimeter is down to 0.16 m from the ground. The ground reflection effect for the gamma rays decreases as the height of the recovery capsule increases. Therefore, the gamma-dose level at useful load in the recovery capsule will meet flight-safety requirements.

Author (AIAA)

Radiation Dosage; Gamma Rays; Space Capsules; Altimeters; Recoverable Spacecraft; Cesium 137; Radiation Distribution; Aerospace Safety

19980058941

Numerical approach to combustion in ramjet engines via a multidomain method ***Approche numerique de la combustion dans les statoreacteurs par une methode multidomaine***

Sitbon, David, Aerospatiale Missiles, France; Errera, Marc P., ONERA, France; ONERA, TP no. 1997-63; 1997; In French

Report No.(s): ONERA, TP no. 1997-63; Copyright; Avail: Aeroplus Dispatch

A numerical approach is proposed for predicting and investigating reaction phenomena in ramjet engine combustion chambers. This approach is based on a turbulent combustion model and the application of an extremely flexible multidomain method.

The present study relies on the MATHILDA code. The proposed approach is used to solve the multispecies compressible 3-D averaged Navier-Stokes equations using an implicit structured finite volume formulation for modeling k-L turbulence.
AIAA
Ramjet Engines; Turbulent Combustion; Turbulence Models

19980058992

Thermal analysis of re-entry vehicle structure

Ohtake, Kunihiko, National Aerospace Lab., Japan; Endo, Shuji, National Aerospace Lab., Japan; Ogawa, Satoru, National Aerospace Lab., Japan; Haneji, Kazuhiko, LTCB Systems Co., Japan; Kamohara, Mitsuko, Marine and River Technology, Japan; 1997, pp. 923-932; In English
Report No.(s): AAS Paper 97-482; Copyright; Avail: Aeroplus Dispatch

Using our newly developed numerical simulation system, we investigated the thermal behavior of reentry vehicle structures. The effects of aerodynamic heating over the entire structure were simulated and, for the nose cone section, the effects of radiative heat transfer from the internal hot surface to the frame structure were simulated. A radiation solver based on ray tracing was used. The effects of joint insulater and emissivity were investigated. The importance of the precise evaluation of local thermal properties was emphasized.
Author (AIAA)
Reentry Vehicles; Digital Simulation; Aerodynamic Heating; Aerothermodynamics; Radiative Heat Transfer

19980059105

Development study on ATREX engine for future spaceplane

Sato, Tetsuya, Inst. of Space and Astronautical Science, Japan; Tanatsugu, Nobuhiro, Inst. of Space and Astronautical Science, Japan; Naruo, Yoshihiro, Inst. of Space and Astronautical Science, Japan; Mizutani, Tomoaki, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Omi, Junsuke, Ishikawajima-Harima Heavy Industries Co., Ltd., Japan; Tomike, Junichiro, Kawasaki Heavy Industries, Ltd., Japan; Kazari, Masahide, Kawasaki Heavy Industries, Ltd., Japan; Minami, Ryuichi, Mitsubishi Heavy Industries, Ltd., Japan; 1997, pp. 241-249; In English
Report No.(s): AAS Paper 97-422; Copyright; Avail: Aeroplus Dispatch

An expander cycle air turbo ramjet engine called ATREX is being considered at the Institute of Space and Astronautical science as a candidate for the propulsion system of the flyback booster of the TSTO spaceplane. The ATREX with an air-cooling system has the advantage of effective thrust and specific impulse over the wide flight range from liftoff to Mach 6 at an altitude of 30 km. The firing test results of the ATREX engine with installed precooler and regeneratively cooled combustion chamber at the SLS condition are presented. The structural reliability and heat exchange performances of both of these components are confirmed. The engine thrust and specific impulse are improved by air precooling.
Author (AIAA)
Ramjet Engines; Turbojet Engines; Product Development; Aerospace Planes; Japanese Space Program; Japanese Spacecraft

19980059107

Development study on precooler for ATREX engine

Harada, Kenya, Inst. of Space and Astronautical Science, Japan; Yamauchi, Hiroshi, Inst. of Space and Astronautical Science, Japan; Tanatsugu, Nobuhiro, Inst. of Space and Astronautical Science, Japan; Sato, Tetsuya, Inst. of Space and Astronautical Science, Japan; Okabe, Yoriji, Inst. of Space and Astronautical Science, Japan; Hamabe, Kenji, Kawasaki Heavy Industries, Ltd., Japan; Tomike, Junichiro, Kawasaki Heavy Industries, Ltd., Japan; Kazari, Masahide, Kawasaki Heavy Industries, Ltd., Japan; 1997, pp. 251-257; In English
Report No.(s): AAS Paper 97-423; Copyright; Avail: Aeroplus Dispatch

Two types of precooler were manufactured for integration into the ATREX engine and tested at the sea level static condition. In this report, the test results for the thermal and hydraulic characteristics of these precoolers are shown and compared with analytical predictions. The problem of nonuniformity of the air flow in the precooler is examined by numerical calculation.
Author (AIAA)
Precooling; Engine Design; Rocket Engines; Product Development; Ramjet Engines; Turbojet Engines

19980062487

Zero-gravity damage evaluation (Z-GraDE)

Smith, Suzanne W., Kentucky, Univ., Lexington, USA; Eckert, Jennifer C., Kentucky, Univ., Lexington; Zimmerman, David C., Houston, Univ., USA; 1998, pp. 158-164; In English; Copyright; Avail: Aeroplus Dispatch

We present experiments for verification of damage detection technology that were conducted in a 0-g environment. This project was a part of the 1997 NASA Student Flight Opportunities Program in which 23 teams of undergraduate students were chosen to conduct experiments on the NASA KC135 aircraft. A planar truss structure was selected as the test article. Modal tests of various undamaged and damaged configurations of the structure using impact excitation were performed during the flight and on the ground (before and after the flight). This paper presents the details of the concept, flight data, data processing, and modal identification results.
Author (AIAA)
Weightlessness; Damage Assessment; C-135 Aircraft; Ground Tests; Preflight Analysis

19980064102

Comment on 'Six-degree-of-freedom entry dispersion analysis for the METEOR Recovery Module'

McGusker, Todd, GB Tech/Space Industries, USA; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 117; In English; Copyright; Avail: Aeroplus Dispatch

Attention is drawn to comments on the identified work by McCusker and Hill (1993) that are felt to be misleading. The work in question is a comprehensive reentry dispersion analysis that employs an innovative Monte Carlo technique.
AIAA
Recoverable Spacecraft; Spacecraft Modules; Aerodynamic Coefficients; Dispersing; Spacecraft Reentry

19980064103

Reply by the authors to T. McCusker

Desai, Prasun N., NASA Langley Research Center, USA; Braun, Robert D., NASA Langley Research Center, USA; Powell, Richard W., NASA Langley Research Center, USA; Engelund, Walter C., NASA Langley Research Center, USA; Tartabini, Paul V., NASA Langley Research Center, USA; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 117, 118; In English; Copyright; Avail: Aeroplus Dispatch

METEOR program managers concluded the unsuitability of the McCusker and Hill (1993) aerodynamic data base after comparisons were made with the Desai et al. (1997) study results. The basis for this judgment was the use by Desay et al. of extensive CFD analyses and wind tunnel measurements.
AIAA
Spacecraft Modules; Spacecraft Reentry; Recoverable Spacecraft; Space Exploration; Aerodynamic Coefficients

19980064510

Magnetohydrodynamic propulsion using on-board sources

Martin, James A., Alabama, Univ., Tuscaloosa, USA; 1998, pp. 985-990; In English
Contract(s)/Grant(s): NAG8-1322; Copyright; Avail: Aeroplus Dispatch

Magnetohydrodynamics is considered to extract power from flow and to inset power into flow at different points in propulsion systems that might be useful for advanced Earth-to-orbit vahicles. No beamed power is considered, and so the power is all generated from on-board sources. An ideal analysis is used as the first step toward deciding which concepts to examine further. The airbreathing engine concept that uses magnetohydrodynamics to replace the rotating machinery in a turbojet engine provides the most attractive results.
Author (AIAA)
Magnetohydrodynamics; Spacecraft Propulsion; Turbojet Engines; Orbit Insertion; Earth Orbital Environments

19980064516

Cassini nuclear risk analysis with SPARRC

Ha, Chuong T., Lockheed Martin Missiles & Space, USA; Deane, Nelson A., Lockheed Martin Missiles & Space, USA; 1998, pp. 1275-1280; In English
Contract(s)/Grant(s): DE-AC03-91SF-18852; Copyright; Avail: Aeroplus Dispatch

The nuclear risk analysis of the Cassini mission is one of the most comprehensive risk analyses ever conducted for a space nuclear mission. The complexity of postulated accident scenarios and source term definitions, from launch to Earth swingby, has necessitated an extensive series of analyses in order to provide best-estimates of potential consequence results and bounding uncertainty intervals. The Space Accident Radiological Release and Consequence (SPARRC) family of codes, developed by Lockheed Martin to analyze polydispersed source terms and a combination of different atmospheric transport patterns, has been used for the Cassini Final Safety Analysis Report (FSAR). by identifying dominant contributors, the nuclear risk of each mission

segment is understood with a high level of confidence. This paper provides the overall analysis process and insights developed from the risk analysis.
Author (AIAA)
Cassini Mission; Flight Safety; Nuclear Radiation

19980064517

Lessons learned from the Galileo and Ulysses flight safety review experience

Bennett, Gary L., Metaspace Enterprises, USA; 1998, pp. 1269-1274; In English; Copyright; Avail: Aeroplus Dispatch

In preparation for the launches of the Galileo and Ulysses spacecraft, a very comprehensive aerospace nuclear safety program and flight safety review were conducted. A review of this work has highlighted a number of important lessons which should be considered in the safety analysis and review of future space nuclear systems. These lessons have been grouped into six general categories: establishment of the purpose, objectives, and scope of the safety process; establishment of charters defining the roles of the various participants; provision of adequate resources; provision of timely peer-reviewed information to support the safety program; establishment of general ground rules for the safety review; and agreement on the kinds of information to be provided from the safety review process.
Author (AIAA)
Flight Safety; Galileo Spacecraft; Ulysses Mission; Nuclear Radiation

19980064661

Current status of the H-II Orbiting Plane-Experimental (HOPE-X) development

Fukui, Toshio, NASDA, HOPE Joint Office, Japan; Miho, Kazuyuki, NASDA, HOPE Joint Office, Japan; Nakano, Eiichiro, NASDA, HOPE Joint Office, Japan; 1998, pp. 937-942; In English; Copyright; Avail: Aeroplus Dispatch

The objective of the (HOPE-X) project is to develop the major technologies necessary for two-way space transportation systems on the basis of precursor elemental flight experiments, such as OREX, HYFLEX, and ALFLEX, and to demonstrate them through the flight experiment of an operational size vehicle. At present, the HOPE-X project is in the development phase, and various efforts for system design and fundamental technologies are being conducted through cooperation between the National Aerospace Laboratory (NAL) and NASDA. The plan to improve the HOPE-X vehicle after the flight experiment and to use it for practical missions is also investigated.
Author (AIAA)
Space Transportation System; Japanese Space Program; Thermal Protection; Spacecraft Design; Aerodynamic Configurations

19980064910

Wind profile models - Past, present and future for aerospace vehicle ascent design

Smith, O. E., Computer Sciences Corp., USA; Adelfang, S. I., Computer Sciences Corp., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-1047; Copyright; Avail: Aeroplus Dispatch

The paper presents the evolution of wind statistics and wind models established for the Saturn Program through the development of the vector wind profile model used for the Shuttle design to the variations of this wind modeling concept for the X-33 program. The wind profile models, wind loads statistical analysis, and wind profile measurement system are described, and future tasks and recommendations are given.
AIAA
X-33 Reusable Launch Vehicle; Wind Profiles; Ascent Trajectories; Flight Control; NASA Space Programs; Trajectory Analysis

19980066937

Numerical optimization study of aeroassisted orbital transfer

Zimmermann, Frank, Stuttgart, Univ., Germany; Calise, Anthony J., Georgia Inst. of Technology, Atlanta; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 127-133; In English
Contract(s)/Grant(s): NAG1-1139; Copyright; Avail: Aeroplus Dispatch

A direct multiple-shooting method has been applied to the optimization of an aeroassisted orbital transfer. The objective has been to provide optimal trajectories for a vehicle with a high lift-over-drag ratio that minimizes the energy loss during the atmospheric part of an aeroglide maneuver subject to limits on heating rate. In addition, thrusting segments have been inserted within the atmospheric part of the trajectory, and both aeroglide and aerocruise trajectories have been evaluated. Here, the objective has been to maximize the achievable inclination change subject to limits on heating rate, total heat load, and lift coefficient. The

respective parameter optimization procedures have been set up as multiphase optimization problems. All guidance-related parameters along the trajectory, together with the deorbiting, boost, and circularizing impulses, have been optimized.
Author (AIAA)
Aeroassist; Transfer Orbits; Lift Drag Ratio; Aerodynamic Forces; Trajectory Optimization

19980067709
The NASA High Intensity Radiated Fields Laboratory
Williams, Reuben A., NASA Langley Research Center, USA; 1997, pp. 4.2-17 to 4.2-21; In English; Copyright; Avail: Aeroplus Dispatch

High Intensity Radiated Fields (HIRF) are the result of a multitude of intentional and nonintentional electromagnetic sources that currently exists in the world. Many of today's digital systems are susceptible to electronic upset if subjected to certain electromagnetic environments. Aerospace designers and manufacturers increasingly rely on sophisticated digital electronic systems to provide critical flight control in both military, commercial, and general aviation aircraft. In an effort to understand and emulate the environment to which high energy RF subjects electronics, the Electromagnetics Research Branch of the Flight Electronics and Technology Division conducts research on RF and microwave measurement methods related to the understanding of HIRF. In the High Intensity Radiated Fields Laboratory, the effects of high energy radiating electromagnetic fields on avionics and electronic systems are tested and studied.
Author (AIAA)
Electromagnetic Radiation; Flight Control; Aerospace Engineering

19980067754
Avionics systems technology, development, and applications
Andrew, George N., Litton Amecom/Space Systems Operation, USA; 1997, pp. 6.4-10 to 6.4-16; In English; Copyright; Avail: Aeroplus Dispatch

NASA's New Millennium Program (NMP) is adopting the faster-better-cheaper philosophy to enable NASA to maintain low-cost, high, and evolving technology satellites. Industry has responded by designing, developing, and manufacturing a single-chip, radiation-hardened flight computer processor and as well as a single-chip, radiation-hardened MIL-STD-1553B/1773 Remote Terminal (RT). NASA's NMP Microwave Anisotropy Probe (MAP) and the Earth Orbiter-1 (EO-1) are the first satellites to be utilizing the rad-hard integrated spacecraft bus co-developed with industry. The rad-hard spacecraft bus incorporates: the rad-hard 12-MHz 32-bit single board Mongoose 5 flight computer with attached 1.4-Gbit solid state recorder. The radiation total dose rating is 1 MRad, an LET of greater than 80 MeV*sq cm/mg for single event upsets, and no latchup. The United Technologies Mircroelectronics Center rad-hard UT69R000 microprocessor has a radiation total dose rating of 100 Krad, an LET of greater than 35 MeV*sq cm/mg for single event upsets, and no latchup, as the center of each of the smart MIL-STD-1553B/1773 RTs which incorporates an operating system.
Author (AIAA)
Avionics; Systems Engineering; Research and Development; Technology Utilization; Airborne/Spaceborne Computers; Satellite Attitude Control

19980067779
New low cost avionics with INS/GPS for a variety of vehicles
Martin, Michael K., Boeing North American, Inc., USA; Vause, Diane A., Coleman Aerospace Co., USA; 1997, pp. 8.3-1 to 8.3-8; In English; Copyright; Avail: Aeroplus Dispatch

Development of a new vehicle avionics suite is described, including integration of a low-cost, tightly coupled integrated INS/GPS to support vehicle guidance, navigation, and control (GN&C). A wide variety of next-generation low-cost launch vehicles could potentially benefit from integrated INS/GPS technology for GN&C and/or range safety applications. Coleman Aerospace Company (CAC) has developed a new low-cost avionics suite, the generic Integrated Mission Guidance & Tracking System (IMGTS), an open architecture, modular system that supports the requirements for various guidance applications and range safety tracking. As part of this development, Boeing North American, Inc. is supplying its Modular Miniature Integrated GPS/INS Tactical System (M-MIGITS) military off the shelf (MOTS) INS/GPS product to support CAC's IMGTS GN&C. This paper summarizes the avionics product development, integration, and test. The potential user requirements and their avionics requirements are described. History and rationale for the avionics development is outlined, and the overall avionics design is discussed in detail, along with key performance/functional characteristics.
Author (AIAA)
Low Cost; Avionics; Inertial Navigation; Global Positioning System; Launch Vehicles

19980067780

A modular distributed avionics architecture for launch vehicles

Prevost, Stanley E., Phase IV Systems, Inc., USA; 1997, pp. 8.3-9 to 8.3-15; In English; Copyright; Avail: Aeroplus Dispatch

Consideration is given to the architecture and design of a Modular Distributed Avionics System (MDAS) for launch vehicles which attempt to lower costs in several ways. These include: use of commercial components and processes; common module design, including flexible sensor signal conditioning and flexible valve control; reduction of cabling cost and weight; elimination of power conditioning requirements; reduction of battery requirements; use of ISO 11898 CAN serial command and data bus; total programmability via umbilical; and standard software with all commands and functions that are customized to a specific application via an overlay of a high-level definition of the operational sequence and timeline.

Author (AIAA)

Avionics; Launch Vehicles; Systems Engineering

19980070637

National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Airborne Sounder Testbed-Interferometer (NAST-I)

Cousins, Dan, MIT, USA; Smith, William L., NASA Langley Research Center, USA; 1997, pp. 323-331; In English
Contract(s)/Grant(s): F19628-95-C-0002; Copyright; Avail: Aeroplus Dispatch

An airborne Fourier transform interferometric sounder is being developed to perform atmospheric measurements for NPOESS. The interferometer is designed to provide high spectral resolution, low noise data from the NASA ER-2 aircraft suitable for synthesizing and comparing data of potential future satellite-borne sounding instruments, such as AIRS, IMAS, ITS, or IASI. The collecting and scanning optics provide a 7.5-deg FOV (2.6-km nadir footprint) over a cross-track field of regard of +/- 48.2 deg. The interferometer operates with a +/-2.0-cm optical path difference over the spectral range from 3.6-16.1 microns. Dynamic alignment is performed using a concentric HeNe laser. Three separate filter/lens/detector assemblies are cooled to 65 K using integral rotary stirling coolers. Most of the optical instrumentation is contained within a pressurized N2 enclosure to minimize the effects of descent condensation. The instrument processor/controller is based on a 133 MHz Pentium CPU supporting a dedicated digital signal processor for real-time x 16 data decimation.

Author (AIAA)

Atmospheric Sounding; Satellite-Borne Instruments; Aircraft Instruments; Test Stands

19980071356

Hypersonic thermal environment of a proposed single-stage-to-orbit vehicle

Weilmuenster, K. J., NASA Langley Research Center, USA; Gnoffo, P. A., NASA Langley Research Center, USA; Greene, F. A., NASA Langley Research Center, USA; Riley, C. J., NASA Langley Research Center, USA; Hamilton, H. H., II, NASA Langley Research Center, USA; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 697-704; In English; Copyright; Avail: Aeroplus Dispatch

The thermal environment of a representative SSTO winged body vehicle has been investigated at a Mach number of 21.89 and an altitude of 233,000 ft, which corresponds to the peak heating condition on a nominal re-entry trajectory. Both surface heating and temperatures are mapped for the baseline configuration and for control surfaces both fixed (tip fins) and deflected (body flap and elevons). The thermal environment is predicted for angles of attack of 28, 32, and 36 deg; for body flap deflections of 10 and 20 deg; and for a matrix of tip fin parameters based on leading-edge radius and leading-edge sweep angle. The analysis is based on laminar flow in chemical equilibrium and chemical nonequilibrium, including catalytic surface effects. The analysis shows that, in the vicinity of the wing fuselage juncture and tip fin leading edge, the localized heating can be as much as three times, and temperatures as much as one-third greater than those found at the stagnation point. These extremes are the result of shock interactions that are influenced by vehicle aerolines and attitude, as well as the chemical state of the gas in the flow field.

Author (AIAA)

Single Stage to Orbit Vehicles; Thermal Environments; Hypersonic Heat Transfer; Aerothermodynamics; Reentry Effects; Reentry Vehicles

19980071374

Neutral orbital altitude density effects on the International Space Station

Smith, O. E., Computer Sciences Corp., USA; Adelfang, S. I., Computer Sciences Corp., USA; Smith, R. E., Computer Sciences Corp., USA; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 817-823; In English; Copyright; Avail: Aeroplus Dispatch

One of the design requirements of the International Space Station (ISS) is that, each year, accelerations of 1 micro-g cannot be exceeded at the ISS internal payload location for six periods of not less than 30 consecutive days. This study deals only with the accelerations caused by atmospheric drag. The critical ambient neutral density, computed using the Marshall engineering thermosphere model, required to produce accelerations of 1 micro-g on the ISS, is estimated using an atmospheric-drag acceleration equation. Results show that the design requirements may be difficult to meet during periods of extremely high solar activity; the planned reboost and altitude strategies for the ISS may have to be revised to allow for the uncertainty in the prediction of neutral atmospheric density within the 100-day period established for orbital decay before reboost.

Author (AIAA)

International Space Station; Aerodynamic Drag; Atmospheric Density; Earth Orbital Environments; Spacecraft Orbits

19980071926

Preliminary study of differential force modelling on ERS-1 and ERS-2

Moore, P., Aston Univ., UK; Ehlers, S., Aston Univ., UK; Advances in Space Research; 1997; ISSN 0273-1177; Volume 19,, no. 11, pp. 1655-1659; In English; Copyright; Avail: Aeroplus Dispatch

ERS-1 and -2 are orbiting the Earth on the same orbit and orbital plane with a 32-min separation. The residual signature of the satellite's repeating ground-track, yielded by differencing their altimetric data, will be a function of (1) imprecise altimetric correlations, but also, and more significantly, from (2) temporal variations in forces affecting both satellites due to lunisolar attraction and aerodynamic force modeling. Attention is given to differential force modelling results that emphasize aerodynamic effects.

AIAA

ERS-1 (ESA Satellite); ERS-2 (ESA Satellite); Satellite Orbits; Orbit Calculation; Earth Orbits; Aerodynamic Forces

19980071930

Surface forces parameterization of GFZ-1 orbits and gravity field recovery

Koenig, R., Potsdam, GeoForschungsZentrum, Germany; Bode, A., Potsdam, GeoForschungsZentrum, Germany; Chen, Z., Potsdam, GeoForschungsZentrum, Germany; Reigber, Ch., Potsdam, GeoForschungsZentrum, Germany; Advances in Space Research; 1997; ISSN 0273-1177; Volume 19,, no. 11, pp. 1677-1680; In English; Copyright; Avail: Aeroplus Dispatch

At its altitude of less than 400 km, the small laser satellite GFZ-1 is subject to exceptionally large orbit perturbations by surface forces, which then have to be modeled in a way that separates the gravity signal needed for the gravity field solution that is the mission's objective. Attention is here given to two aspects of the gravity field solution process.

AIAA

Satellite Orbits; Gravitational Fields; Orbit Perturbation; Aerodynamic Forces

19980071934

Nongravitational forces acting on the CHAMP satellite

Sehnal, L., Czech Academy of Sciences, Astronomical Inst., Czech Republic; Pospisilova, L., Czech Academy of Sciences, Astronomical Inst., Czech Republic; Vokrouhlicky, D., Charles Univ., Czech Republic; Kohlhase, A., Berlin, Technical Univ., Germany; Advances in Space Research; 1997; ISSN 0273-1177; Volume 19,, no. 11, pp. 1695-1698; In English; Copyright; Avail: Aeroplus Dispatch

The CHAMP smallsat, scheduled for launch in 1999, carries a three-axis microaccelerometer with cubic proof-mass that is sensitive to linear as well as angular accelerations. A determination is presently made of the magnitudes of atmospheric drag and lift and radiative effect based nongravitational disturbances, and the analytical theory of long-term atmospheric effects is used to estimate the CHAMP satellite's service life.

AIAA

Satellite Orbits; Accelerometers; Three Axis Stabilization; Angular Acceleration; Lift Drag Ratio

19980071935

A comparative study on methods to determine gas densities with San Marco 5

Enninghorst, K., Potsdam, GeoForschungsZentrum, Germany; Roemer, M., Bonn, Univ., Germany; Advances in Space Research; 1997; ISSN 0273-1177; Volume 19,, no. 11, pp. 1699-1702; In English; Copyright; Avail: Aeroplus Dispatch

The San Marco 5 satellite has been used to independently obtain three different data sets of the total gas density along the satellite's trajectory. The studies respectively had their basis on the methods of (1) a drag balance instrument measurement of

ambient gas aerodynamic pressure; (2) an orbital drag analysis that yielded a set of perigee densities; and (3) a derivation of mean gas densities from the observed deceleration of the satellite's spin.
AIAA
Gas Density; Spacecraft Trajectories; Drag Measurement; Aerodynamic Forces; Satellite Orbits

19980072976

Statistical combination of launch vehicle gust and buffet atmospheric flight loads

Spiekermann, C. E., Aerospace Corp., USA; Kabe, A. M., Aerospace Corp., USA; 1998, pp. 3129-3137; In English
Report No.(s): AIAA Paper 98-2010; Copyright; Avail: AIAA Dispatch

During atmospheric flight a launch vehicle and its payload will experience severe structural loads from several different phenomena, such as loads due to atmospheric gusts and loads due to buffet, which are generally two significant load contributors. Since these loads can occur simultaneously, an approach is taken so that they are statistically combined with other loads to estimate a total. A critical issue is the proper statistical combination of loads from these two events. This paper presents results of a study in which load response time histories were combined in a Monte Carlo analysis to establish total vehicle load. These load levels were then used to establish the proper buffet load split, between the mean and dispersed portions, that should be combined with the gust load in a standard loads combination equation. The results of the study support the conclusion that the mean and dispersed buffet loads should be computed from the envelope function of the buffet load time history, which has a nonzero mean.
Author (AIAA)
Launch Vehicles; Aerodynamic Loads; Gust Loads; Buffeting; Aeroelasticity

19980073022

Longitudinal vibration characteristics of the solid rocket vehicle at lift-off

Morino, Yoshiki, NASDA, Japan; Arita, Makoto, NASDA, Japan; Ujino, Takumi, NASDA, Japan; Takahashi, Akisato, Nissan Motor Co., Ltd., Japan; Yagi, Kazuhiro, Nissan Motor Co., Ltd., Japan; Apr. 1998; In English
Report No.(s): AIAA Paper 98-2008; Copyright; Avail: AIAA Dispatch

The influence of propellant motion on the axial vibration of solid rocket motor cases are evaluated via an approximate analytical model which includes the propellant axial motion relative to the surrounding rocket motor case. Propellant behavior in the longitudinal vibration of the cylindrical motor case is discussed using approximate 2D equation systems. A lift-off vibration analysis of the Japanese J-1 solid rocket motor vehicle is presented. Improvement of the vibration models by incorporating the axial shear motion of the first-stage solid propellant into the discrete vibration model is discussed based on the understanding of the propellant behavior demonstrated by the approximate analysis. Results of the vibration analysis are compared with the flight data, and the accuracy of the modeling is discussed.
Author (AIAA)
Solid Propellant Rocket Engines; Vibration Measurement; Lift; Equations of Motion; Solid Rocket Propellants; Shear Stress

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19980049295

Dynamics of compressible gas flow with friction for the investigation of turbo-compressors

Pismenny, J., Technion - Israel Inst. of Technology, Haifa, Israel; Levy, Y., Technion - Israel Inst. of Technology, Haifa; 1998, pp. 266-273; In English; Copyright; Avail: Aeroplus Dispatch

Investigation of systems incorporating compressors, such as in gas turbines, in the complex plane makes it possible to visualize the effect of the characteristics of the system's components on the onset of the surge phenomenon and on its parameters. In the present work, dynamic characteristics are obtained in the form of inverse describing functions of compressible gas flow in a pipe with friction as a system with distributed parameters.
Author (AIAA)
Compressible Flow; Gas Dynamics; Turbocompressors; Gas Turbine Engines; Friction Factor; Rotating Stalls

19980049664

Evaluation of electron-beam cured resins for repair of composite structures

Uleck, Kevin R., Maryland, Univ., College Park, USA; Vizzini, Anthony J., Maryland, Univ., College Park; Journal of Advanced Materials; Oct. 1997; ISSN 1070-9789; Volume 29, no. 1, pp. 38-42; In English; Copyright; Avail: Aeroplus Dispatch

An experimental study was conducted to compare electron beam curing with conventional thermoset curing for composite repair applications. to compare the strength of repairs made with electron beam cured resins to conventional thermally cured epoxy resins, two versions of double strap joints using composite adherends were run. The first version employed a precured patch or doubler, and the second version employed a cocured patch. Results show that the electron beam cured resins compare favorably to conventional systems when used for constructing cocured patches, but do not work well for adhesive bonding of precured patches.

Author (AIAA)

Composite Structures; Synthetic Resins; Curing; Electron Beams; Aircraft Maintenance; Bonded Joints

19980055467

Characterization of laser-heated soot particles using optical pyrometry

McManus, K. R., Physical Sciences, Inc., USA; Frank, J. H., Physical Sciences, Inc., USA; Allen, M. G., Physical Sciences, Inc., USA; Rawlins, W. T., Physical Sciences, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0159; Copyright; Avail: Aeroplus Dispatch

An optical probe for the measurement of soot emissions from gas turbine combustors is under development. The probe is based on laser-induced incandescence (LII), which concerns the rapid heating of soot particles using a pulsed laser and detection of the intense thermal emission from the particles. We give a brief description of a heat transfer model used to describe the transient thermal characteristics during the LII process. Experimental results obtained in simple laboratory flames are presented. An investigation of the LII signature on a timescale of the same order as the laser pulse duration (10.8 ns) suggests that incident laser intensities in excess of 12 MW/sq cm can perturb the particle properties and likely will result in particle mass loss. This result is consistent with previously reported results. A gated monochromator was used to measure particle cooling characteristics after the laser pulse. The measured cooling rates are in good agreement with model predictions in the conductive cooling regime. The results suggest that LII may be used as a diagnostic for both soot volume fraction and particle size distributions in combustion flows.

Author (AIAA)

Characterization; Laser Heating; Soot; Pyrometers; Optical Measuring Instruments; Exhaust Emission; Gas Turbine Engines; Laser Induced Fluorescence

19980055468

Determination of temperature distributions by CARS-thermometry in a planar solid fuel ramjet combustion chamber

Clauss, W., DLR, Germany; Vereschagin, K., Russian Academy of Sciences, Russia; Ciezki, H. K., DLR, Germany; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0160; Copyright; Avail: Aeroplus Dispatch

CARS is used in order to investigate the combustion process of solid fuel slabs with boron particle addition in a step combustor under ramjet-relevant conditions concerning the air inlet temperature. Temperature distributions of the gaseous phase inside the combustor are determined by single-shot nitrogen thermometry at several cross sections. The obtained CARS spectra show partly strong interferences with C2-radicals, especially in the fuel rich region immediately above the solid fuel surface and the recirculation zone. Bimodal temperature histograms have been gathered in the outer zone above the diffusion flame in the developing boundary layer downstream of the recirculation zone. They are caused by the intensive mixing process and the entrainment of colder gas in the outer zone of the reacting boundary layer.

Author (AIAA)

Temperature Distribution; Raman Spectra; Combustion Chambers; Solid Propellant Combustion; Ramjet Engines; Temperature Measurement

19980055660

Quantitive limitations of laser-induced incandescence in practical combustion environments

Wainner, R., Georgia Inst. of Technology, Atlanta, USA; Seitzman, J. M., Georgia Inst. of Technology, Atlanta; Martin, S. R., MetroLaser, Inc., USA; Jan. 1998; In English

Contract(s)/Grant(s): NSF CTS-95-02371

Report No.(s): AIAA Paper 98-0398; Copyright; Avail: Aeroplus Dispatch

Soot mass concentrations were measured with laser-induced incandescence in a nonreacting flow. The behavior of the LII signal with respect to soot concentration, particle size, and temperature was isolated with the use of a controlled soot generating device. This device was also intended to simulate an environment similar to a jet engine exhaust. Reduction of interference signals and high detection sensitivity was achieved with the use of an Nd:YAG laser at its fundamental wavelength and broadband detection from 570 to 850 nm. The technique yielded LII signals nearly proportional to soot concentration over four orders of magnitude, with promise of detecting soot concentration to 1 part per trillion. The detection setup was designed, according to a model of the LII process, to reduce dependence on local gas temperature and soot particle size. Experimental results agreed with the model predictions in terms of particle size dependence. Also, LII signals were observed for gas temperatures from 70 to 300 C, the latter approaching temperatures typical of an engine exhaust. No dependence on temperature was found over this range.
Author (AIAA)
Fuel Combustion; Soot; Jet Engines; Exhaust Gases

19980055868

Theoretical investigation of combustion instability mechanisms in lean premixed gas turbines

Lieuwen, Tim, Georgia Inst. of Technology, Atlanta, USA; Zinn, Ben T., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0641; Copyright; Avail: Aeroplus Dispatch

This paper presents a theoretical investigation of the mechanisms that drive combustion instability in low NO(x) gas turbines (LNGTs). The model developed in this study shows that the interaction of the combustor pressure oscillations with the reactants feed lines produces periodic variation of the reactants equivalence ratio (i.e., unmixedness). This, in turn, produces a 'chain' of combustible gas packets with a periodically varying equivalence ratio that are convected by the mean flow to the combustor, where they produce large amplitude heat release oscillations that drive the combustor procure oscillations. The model is used to determine ranges of system design parameters and characteristic times that produce unstable operation. It is shown that for typical LNGT designs, necessary conditions for the onset of instability can be simply described in terms of a ratio of the reactants' convective time to the combustor and the period of the oscillations.
Author (AIAA)
Gas Turbine Engines; Premixed Flames; Combustion Stability; Nitrogen Oxides; Exhaust Emission; Pressure Oscillations

19980055940

Simultaneous multiplex CARS measurements of temperature and concentrations of H2 and O2 in supersonic hydrogen-air combustion

Yang, S. R., Chinese Academy of Sciences, Inst. of Mechanics, China; Zhao, J. R., Chinese Academy of Sciences, Inst. of Mechanics, China; Yu, G., Chinese Academy of Sciences, Inst. of Mechanics, China; Sung, C. J., Princeton Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0727; Copyright; Avail: Aeroplus Dispatch

H2 and O2 multiplex CARS employing a single dye laser has been explored to simultaneously determine the temperature and concentrations of He and O2 in a hydrogen-fueled supersonic combustor. Systematic calibrations were performed through a well-characterized He/Air premixed flat flame burner. In particular, temperature measurement was accomplished using the intensity ratio of the H2 S(5) and S(6) rotational lines, while extraction of the H2 and O2 concentrations were obtained from the H2 S(6) and O2 Q-branch, respectively. Details of the calibration procedure and data reduction are discussed. Quantification of the supersonic mixing and combustion characteristics applying the present technique has been demonstrated to be feasible. The associated detection limits, as well as possible improvements, are also identified.
Author (AIAA)
Supersonic Combustion; Temperature Measurement; Hydrogen; Oxygen; Raman Spectroscopy

19980056007

Reduced reaction mechanisms for numerical calculations in combustion of hydrocarbon fuels

Kundu, K. P., NASA Lewis Research Center, USA; Penko, P. F., NASA Lewis Research Center, USA; Yang, S. L., Michigan Technological Univ., Houghton; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0803; Copyright; Avail: Aeroplus Dispatch

Two sets of reduced mechanisms are presented for computing combustion reactions of propane, methane, and Jet-A fuel in air for use in CFD codes. One mechanism has 12-species with 13-reaction steps, and the other, 16 species with 23-reaction steps. Temperatures and species concentrations of the oxygen atom and hydroxyl (OH) radicals, for the propane-air reaction, are calculated for the ideal cases of a plug-flow and a well-stirred reactor. The results are compared to computations using a detailed kinetic

mechanism under the same conditions. An experimental case of propane combustion in a lean, premixed, prevaporized flametube is modeled with the computer code, KIVA3, using the reduced mechanisms. The computed results are compared to the experimental results of temperature and NO(x) concentrations. Computational results of flame temperature, using the reduced mechanisms, are obtained for methane-air combustion for the case of a well-stirred reactor and compared to computations with a detailed mechanism. Computations are also made of flame temperature for Jet-A-air combustion in a plug-flow reactor using the two reduced mechanisms. The results demonstrate the applicability of the reduced mechanisms to practical, CFD calculations of combustion processes.
Author (AIAA)
Hydrocarbon Fuels; Computational Fluid Dynamics; Propane; Methane; Jet Engine Fuels; Fuel Combustion; Hydrocarbon Combustion; Computational Chemistry

19980056144

CARS temperature measurements on an air breathing ram jet model

Fischer, M., German Aerospace Research Establishment, Inst. of Propulsion Technology, Germany; Magens, E., German Aerospace Research Establishment, Inst. of Propulsion Technology, Germany; Weisgerber, H., German Aerospace Research Establishment, Inst. of Propulsion Technology, Germany; Winandy, A., German Aerospace Research Establishment, Inst. of Propulsion Technology, Germany; Cordes, S., German Aerospace Research Establishment, Inst. of Propulsion Technology, Germany; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0961; Copyright; Avail: Aeroplus Dispatch

CARS was used to measure nitrogen single pulse spectra at the entrance and exit area of a thrust nozzle. Thermodynamic nonequilibrium effects were proved at the exit of the hypersonic nozzle, belonging to an air-breathing, hydrogen combusting ram jet model. to determine the accuracy of extracted rotational and vibrational temperatures, additional laboratory experiments were performed. The nozzle expansion was characterized by wall pressure measurements.
Author (AIAA)
Raman Spectroscopy; Temperature Measurement; Air Breathing Engines; Hypersonic Nozzles; Ramjet Engines; Nitrogen

19980056567

Creep behaviour of a cast gamma-TiAl based alloy for gas turbine applications

Lundstrom, D., Chalmers Univ. of Technology, Sweden; Karlsson, B., Chalmers Univ. of Technology, Sweden; 1997, pp. 461-468; In English; Copyright; Avail: Aeroplus Dispatch

The creep behavior of the gamma-TiAl based alloy Ti-48Al-2W-0.5Si (at. pct) is investigated in the stress range 80-325 MPa at temperatures from 700 to 850 C. The material was produced by casting, followed by HIP and two successive heat treatments. Variations in the nominal compositions allowed both nearly lamellar (gamma + alpha2) as well as duplex (gamma + lamellar) microstructures to develop. The nearly lamellar microstructure exhibits better creep resistance than the duplex material at lower temperatures/higher stresses, whereas both microstructures have similar creep behavior at higher temperatures/lower stresses. For all conditions the creep rate in regime II passes a minimum at fairly small creep strains followed by gradually increasing creep rates until the onset of tertiary creep in regime III. The tertiary creep takes up a relatively large part of the whole creep lifetime. The creep behavior preceding final fracture depends on nucleation and growth of cavities, as well as on microstructural instability.
Author (AIAA)
Gas Turbine Engines; Titanium Aluminides; Intermetallics; Face Centered Cubic Lattices; Creep Analysis

19980056607

Development and engineering application of a DS cast Ni3Al Alloy IC6

Han, Y. F., Beijing Inst. of Aeronautical Materials, China; Xing, Z. P., Beijing Inst. of Aeronautical Materials, China; Chaturvedi, M. C., Manitoba, Univ., Canada; 1997, pp. 713-719; In English; Copyright; Avail: Aeroplus Dispatch

A directionally solidified casting Ni3Al base alloy, named Alloy IC6, has recently been developed at the Beijing Institute of Aeronautical Materials. The alloy not only has high strength and ductility from room temperature to 1200 C and excellent creep resistance over a wide temperature range of 700 to 1100 C, but also exhibits very good thermal cycle fatigue resistance and a high incipient melting point (T(m) = 1310 - 1320 C), which are very important for aircraft engine turbine vanes. In order to improve its oxidation and corrosion resistance, an overlay NiCrAlYSi coating system has been developed for operating temperature up to 1100 C. Alloy IC6 has been successfully applied for the turbine vanes of an advanced aircraft engine, and it passed 250-h engine tests as well as 30 take off/landing cycles and 15 flight h.
Author (AIAA)
Nickel Aluminides; Intermetallics; Directional Solidification (Crystals); Cast Alloys; Aircraft Engines; Fatigue Life

19980056725

Effects of magnetization on wear

Kumagai, Kazuo, Akita Univ., Japan; Kamiya, Osamu; Tribology Transactions; Oct, 1997; ISSN 0569-8197; Volume 40, no. 4, pp. 621-626; In English; Copyright; Avail: Issuing Activity

The repeated wear tests between a ferromagnetic pin and a paramagnetic rotor indicate that the abrasive action of the wear particles attracted to the pin by magnetic force increases the wear amount of the rotor when the difference in micro-Vickers hardness between the wear particles and the rubbing surface of rotor exceeds 100. Furthermore, the pin magnetized by AC current for a virgin surface increases wear.

Author (EI)

Wear; Rotors; Ferromagnetic Materials; Magnetization; Electric Current

19980057752

Fabrication of ceramic/ceramic composites from aluminum/ceramic composites produced by pressure infiltration

Narciso-Romero, F. J., Alicante, Univ., Spain; Rodriguez-Reinoso, F., Alicante, Univ., Spain; Louis, E., Alicante, Univ., Spain; Garcia-Cordovilla, C., Industria Espanola del Aluminio, Spain; Scripta Materialia; Jan. 13, 1998; ISSN 1359-6462; Volume 38, no. 4, pp. 623-629; In English; Copyright; Avail: Aeroplus Dispatch

A new method is proposed to produce ceramic/ceramic composites which consists of heat treating in different atmospheres (argon and nitrogen) aluminum/ceramic composites previously obtained by pressure infiltration. The method is an alternative to those based upon powder metallurgy techniques, reducing the inhomogeneities inherent to the latter. The aim of the work is to introduce the method and describe the variety of composites that can be obtained and the reactions through which they are produced.

AIAA

Ceramic Matrix Composites; Infiltration; Aircraft Engines; Thermal Stability; Sialon; Reaction Bonding

19980060123

Applications of continuous fiber reinforced ceramic composites in military turbojet engines

Spriet, Patrick, SEP, France; Habarou, Georges, SEP, France; Key Engineering Materials; 1997; ISSN 1013-9826; Volume 13, pt. 3, pp. 1930-1933; In English; Copyright; Avail: Aeroplus Dispatch

This paper is an overview of the main ceramic matrix composite component demonstrations performed by SEP over the last 10 years for turbojet engines. The development status of a new thermostructural material specifically developed for turbojet environment with the prospect of higher design stress allowables and longer operating life at high temperature is presented.

Author (AIAA)

Ceramic Matrix Composites; Fiber Composites; Turbojet Engines; Exhaust Systems; Engine Parts

19980060137

Application potential of fiber reinforced ceramics

Schaefer, W., Daimler-Benz/Dornier Research Center, Germany; Plege, B., Daimler-Benz/Dornier Research Center, Germany; Vogel, W. D., Daimler-Benz/Dornier Research Center, Germany; Key Engineering Materials; 1997; ISSN 1013-9826; Volume 13, pt. 3, pp. 1966-1969; In English; Copyright; Avail: Aeroplus Dispatch

Nextel fiber-reinforced oxide ceramics as well as C/SiC were produced by the liquid polymer infiltration and pyrolysis process. Using short fiber reinforcement the cost can be drastically reduced. The main application areas are hot aerospace components for the continuous fiber-reinforced material and high performance brakes for the short fiber-reinforced material.

Author (AIAA)

Ceramic Matrix Composites; Fiber Composites; Pyrolysis; Aircraft Engines; Engine Parts

19980061827

Probabilistic mesomechanics for high cycle fatigue life prediction

Tryon, Robert G., PerSyst Development Group, USA; Cruse, Thomas A., Vanderbilt Univ., USA; 1997, pp. 467-474; In English Contract(s)/Grant(s): NGT-51053; Copyright; Avail: Aeroplus Dispatch

This paper presents an analytical modeling approach to characterize and understand high cycle fatigue life in gas turbine alloys. It is recognized that the design of structures subjected to fatigue cannot be based on average material behavior but that designs must consider -3sigma or some other appropriate extreme value (tail of the distribution) loading and/or material properties. Thus, a life prediction capability useful in a design application must address the scatter inherent in material response to fatigue loading. Further, the life prediction capability should identify the key micromechanical variables that are critical in the tail of the

scatter in the materials durability distribution. The proposed method addresses the scatter in fatigue by investigating the microstructural variables responsible for the scatter and developing analytical and semianalytical models to quantitatively relate the variables to the response. The model is general and considers the entire range of damage accumulation sequences, from crack nucleation of the initially unflawed structure to final fast fracture.
Author (AIAA)
Fatigue Life; Cyclic Loads; Cumulative Damage; Fatigue Tests; Gas Turbine Engines

19980061829

Micromechanics of high cycle fatigue in single and polycrystals

Lin, T. H., California, Univ., Los Angeles, USA; Wong, K., California, Univ., Los Angeles; Teng, N. J., California, Univ., Los Angeles; 1997, pp. 475-484; In English
Contract(s)/Grant(s): F49629-96-1-350; Copyright; Avail: Aeroplus Dispatch

The micromechanic analysis of a fatigue band in the most favorably oriented crystal at the free surface of a polycrystal is reviewed. The localization of plastic strain in thin slip bands under monotonic loadings and the ratchet mechanism of fatigue bands provided by the stress fields of two closely located parallel thin slices sliding in opposite directions are shown. Each of these two thin slices slides monotonically. The alternate sliding of the two thin slices results in the macroscopic forward and backward plastic strain in cyclic loading. Single crystals are used in turbine engine parts. The fatigue band analysis of polycrystals is extended to analyze the fatigue band in single crystals. Hysteresis loops of a single crystal under constant stress amplitudes and under constant plastic strain amplitudes are shown. Two sets of these hysteresis loops, one with small initial stress and one with large initial stress, are presented. These calculated hysteresis loops explain the two diagonal sharp corners in each loop to be due to reversals of loadings.
Author (AIAA)
Turbine Engines; Fatigue Life; Cyclic Loads; Plastic Deformation; Face Centered Cubic Lattices; Crystal Dislocations

19980062900

Advanced coatings for use in engine systems as protection of performance deterioration

Tabakoff, W., Cincinnati, Univ., USA; Shanov, V., Cincinnati, Univ., USA; 1997, pp. 401-410; In English
Contract(s)/Grant(s): NSF INT-92-04963; Copyright; Avail: Aeroplus Dispatch

Aircraft gas turbines, steam turbines and coal-utilization turbines operating under particulate flows are exposed to erosion wear and performance deterioration. This paper describes an experimental method used to find the erosion behavior of ceramic coatings on superalloys such as INCO 718, Waspaloy, and SS410, subjected to gas-particulate flows at high temperatures. Experimental studies were conducted to investigate the erosion behavior of coatings exposed to different types of solid particles. Some of the following coatings were evaluated: rhodium platinum-aluminized, SDG-2207, CVD coatings (including TiC, TiN, and Al2O3), and ion-nitrided alloys. The erosive wear of the samples was studied experimentally by exposing them to particle laden flow at velocities from 180 to 305 m/s, temperatures from ambient to 815 C, and impingement angles from 20 through 90 deg. In addition, several thermal barrier coatings such as YSZ, ZTY and Al2O3 were also investigated.
Author (AIAA)
Aircraft Engines; Protective Coatings; Thermal Control Coatings; Ceramic Coatings; Heat Resistant Alloys; Wear Resistance

19980067018

An assessment of the DARPA Affordable Polymer Matrix Composite program

Veitch, Lisa C., Inst. for Defense Analyses, USA; Crowe, C. R., DARPA, USA; 1997, pp. 220-233; In English; Copyright; Avail: Aeroplus Dispatch

This paper is a summary of a technical assessment of the Defense Advanced Research Projects Agency (DARPA) Affordable Polymer Matrix Composite (PMC) program. The projects under this program were initiated to develop and demonstrate technologies that would (1) reduce the acquisition costs of composites for high-performance air vehicles and other platforms by 30+ percent, (2) develop a composite structure equal to or lower than the cost of a metallic structure for transports and other 'lower performance' applications, and (3) reduce prototype tooling costs and lead times by 40+ percent. The projects that were originally planned had to refocus their efforts and/or finish earlier than planned. This paper summarizes the technical achievements of these projects and assesses the readiness of the technologies for systems applications. The process and exit criteria that were developed to assess the technology readiness are also discussed.
Author (AIAA)
Polymer Matrix Composites; Cost Reduction; Research and Development; Aircraft Industry

19980067025

Adhesive and composite properties of cured imide oligomers containing pendent and terminal phenylethynyl groups

Connell, John W., NASA Langley Research Center, USA; Smith, Joseph G., Jr., NASA Langley Research Center, USA; Hergenrother, Paul M., NASA Langley Research Center, USA; 1997, pp. 317-331; In English; Copyright; Avail: Aeroplus Dispatch

As part of a program to develop high performance/high temperature structural resins for aeronautical applications, imide oligomers with calculated number average molecular weights of 5000 g/mole containing pendent and terminal phenylethynyl groups were prepared, characterized, thermally cured, and the cured resins evaluated as adhesives and composite matrix resins. The chemical structure of the oligomer backbone was altered to obtain a resin with an attractive combination of properties including processability using conventional equipment, high mechanical properties, and microcrack resistance. The imide oligomers containing phenylethynyl groups were fabricated into adhesive specimens using titanium adherends and composite specimens using IM-7 fiber. The laminates were fabricated in a vacuum press under 1.4 MPa for 1 hr at 350-371 C. The mechanical properties measured at room and elevated temperature varied depending on the chemical structure of the oligomer backbone. Microcrack resistance was dependent upon the oligomer chemical structure. The neat resin and composite properties of these oligomers and their cured polymers are presented.

Author (AIAA)

Adhesion; Curing; Imides; Oligomers; Phenyls; Aeronautical Engineering

19980068757

Study and development of protective coatings for aircraft compressor blades

Hao, Shanshan, Beijing Inst. of Aeronautical Materials, China; Feng, Zixiu, Beijing Inst. of Aeronautical Materials, China; Liu, Haiping, Beijing Inst. of Aeronautical Materials, China; Wang, Xiaohong, Beijing Inst. of Aeronautical Materials, China; 1997, pp. 557-560; In English; Copyright; Avail: Aeroplus Dispatch

The development of protective coatings for aircraft compressor blades is reviewed, including protective coatings such as TiN by physical vapor deposition. The properties of TiN coatings are analyzed, and the trends in the development of protective coatings for aircraft compressor blades are considered.

Author (AIAA)

Protective Coatings; Compressor Blades; Aircraft Engines; Titanium Nitrides; Vapor Deposition

19980069509

Aviation fuels with improved fire safety; Proceedings of the Workshop, Washington, DC, Nov. 19, 20, 1996

1997; In English

Contract(s)/Grant(s): FAA-93-G-040; MDA972-92-C-0028; ISBN 0-309-05833-3; Copyright; Avail: Aeroplus Dispatch

The present volume on aviation fuels with improved fire safety discusses potential surfactant additives, fire safety in military aircraft fuel systems, rheological tools and methods, and jet fuel chemistry and formulation. Atttention is given to concepts for safe-fuel technology, engine fuel system design issues, applications of vulnerability analysis and test methods to aircraft design, and aircraft fuel system design issues. Other topics addressed include combustion fuel mechanics tools and methods, fundamentals of fuel ignition and flammability, postcrash fuel dispersal, and new concepts in fuel fire research.

AIAA

Aircraft Fuels; Flammability; Conferences; Ignition; Aircraft Fuel Systems; Fire Prevention

19980069510

Fire safety in military aircraft fuel systems

Clodfelter, Robert G., AFP Associates, Inc., USA; 1997, pp. 21-30; In English; Copyright; Avail: Aeroplus Dispatch

It is argued that a switch to a higher flash point fuel similar to JP-5 is possible, that this would result in some fire-safety benefits. An AMK-type fuel may have the potential for more fire-safety benefits, but a conversion to operational aircraft may be impractical in the final analysis. Fuel tank inerting and antistatic fuel additives may be the next big steps for improving the fire safety of commercial aircraft.

AIAA

Aircraft Fuel Systems; Safety; Fire Prevention; Military Aircraft; Flammability; Jet Engine Fuels

19980069511

Rheology - Tools and methods

Khan, Saad A., North Carolina State Univ., Raleigh, USA; Royer, Joseph R., North Carolina State Univ., Raleigh; Raghavan, Srinivasa R., North Carolina State Univ., Raleigh; 1997, pp. 31-46; In English; Copyright; Avail: Aeroplus Dispatch

We give a basic understanding of rheology, a scientific discipline of great utility in characterizing complex, microstructured media. Systems investigated using rheology can typically be classified as soft condensed matter or as complex fluids. Examples include macromolecular systems, such as polymer melts and solutions, gels, and biological fluids, as well as colloidal and multiphase systems, such as dispersions, emulsions, foams, and surfactant solutions. Typically, these materials are viscoelastic, i.e., they exhibit a combination of viscous and elastic properties. Such complex behavior cannot be characterized purely in terms of simple parameters, such as the material viscosity or elastic modulus. This paper indicates the possible applications of rheology towards designing improved aviation fuels. Although an aviation fuel typically behaves like a viscous liquid, the introduction of certain additives can cause the system to show a viscoelastic response.
Author (AIAA)
Rheology; Aircraft Fuels; Research and Development; Propellant Properties

19980069512
Jet fuel chemistry and formulation
Taylor, William F., Exxon Research and Engineering Co., USA; 1997, pp. 47-52; In English; Copyright; Avail: Aeroplus Dispatch

Jet fuel requirements are determined by translating engine and airframe technical needs into specifications. Most civil and military jet fuels are kerosene-based and are predominantly straight-run distillates. Processing and finishing steps can vary considerably and include both chemical treatment and catalytic treatment with hydrogen. Jet fuel contains predominately C8/C9 to C15/C16 hydrocarbons with trace levels of sulfur, oxygen, and nitrogen-containing heteroatoms. Additives, which are tightly controlled in jet fuel, can potentially add low levels of a number of different compounds to the fuel. Jet fuel is transported by a complex system designed to control or eliminate water, particulates, and contamination from other fuels.
Author (AIAA)
Jet Engine Fuels; Chemical Composition; Reactivity

19980069513
Concepts for safe-fuel technology
Wright, Bernard R., Southwest Research Inst., USA; 1997, pp. 53-57; In English; Copyright; Avail: Aeroplus Dispatch

Researchers in the field of fuel safety have been on a quest to find replacements for halon and to develop new safety systems for protection against the ignition and burning of fuel in aircraft accidents. Recommended halon replacements have been announced for commercialization. New and undeveloped technologies include surface enhancement, low volatility, and self-activating powder extinguishment. These technologies may be used individually or may be synergistically combined via micro-encapsulation or specific system applications.
Author (AIAA)
Technology Assessment; Aircraft Fuels; Fire Prevention; Ignition; Aircraft Accidents

19980069518
Fundamentals of fuel ignition and flammability
Sirignano, William A., California, Univ., Irvine, USA; 1997, pp. 97-106; In English; Copyright; Avail: Aeroplus Dispatch

Three fundamental model configurations related to aviation fuel safety are discussed: flame spread above liquid fuel pools, the ignition of gaseous combustible mixtures by hot projectiles, and the ignition and flame propagation of fuel spray/air mixtures. Potential advantages of a two-fuel strategy are identified. The need for further research is identified.
Author (AIAA)
Ignition; Flammability; Aircraft Fuels; Liquid Fuels; Flame Propagation; Fuel Sprays; Combustible Flow

19980069519
Post-crash fuel dispersal
Tieszen, Sheldon R., Sandia National Labs., USA; 1997, pp. 107-119; In English
Contract(s)/Grant(s): DE-AC04-94AL-85000; Copyright; Avail: Aeroplus Dispatch

This paper is a brief overview of work done over the last several decades in determining what happens to jet fuel in aircraft fuel tanks on impact with the ground. Fuel dispersal is discussed in terms of overall crash dynamics, and impact regimes are identified. In a generic sense, the types of flow regimes are identified, and general descriptions of the processes are given. Examples of engineering level tools, both computational and experimental, that are used for analyzing the complex environments are pre-

sented. The concept of risk-based decisions is discussed as a quick way of identifying requirements for developing preventive or mitigation strategies, such as antimisting agents.
Author (AIAA)
Crash Landing; Crashes; Jet Engine Fuels; Aircraft Accidents; Dispersing

19980069520
New concepts in fuel fire research - Final summary report of Short-Term Advisory Services (STAS) team
Dryer, Frederick L., Princeton Univ., USA; 1997, pp. 125-140; In English; Copyright; Avail: Aeroplus Dispatch

The consensus of results and opinions reached by a STAS team review of proposed development strategies for a new fire-resistant fuel for use in Army vehicles is described. It is argued that future work should be proposed and carried out on a systems (fuel, fuel system, engine system, deployment) basis. Fundamental/engineering issues which are important to optimizing the various methods available for fire hazard mitigation have remained unanswered. Future programs should take a more balanced approach in obtaining sufficient fundamental knowledge to guide development of optimum approaches. A conservative cost-benefit ratio is desirable for changes in vehicle performance, range, costs, retrofit, and deployment. Fire hazard reduction is needed to guide selection of appropriate program criteria. Acceptable vehicle/fuel systems modifications criteria need to be established.
AIAA
Fire Prevention; Fuel Combustion; Aircraft Fuels; Jet Engine Fuels; Flammability; Flame Retardants; Hydrocarbon Fuels

19980070262
Microstructure-property relationships in thick plate Al 7050 products
Sankaran, K. K., McDonnell Douglas Corp., USA; Tuegel, E. J., McDonnell Douglas Corp., USA; Kremer, K. L., McDonnell Douglas Corp., USA; Schwartz, D. S., McDonnell Douglas Corp., USA; 1997, pp. 325-333; In English; Copyright; Avail: Aeroplus Dispatch

Thick-plate high-strength aluminum alloys are being considered for use in unitized airframe structures to increase the affordability of commercial and military aircraft. Aluminum producers have improved the quality of thick aluminum plate through special processing that has reduced the size and the deleterious effects of the mid-plane pores typical of plate products of the 1970s and 1980s. The currently available plate products also routinely exhibit properties similar to that of forgings. Thick plate can therefore be competitive with forgings, especially considering the problems of residual stresses and distortions associated with the latter. The challenge is to weigh the cost advantages of thick plate with the property and performance attributes of forgings arising from their more refined microstructures and beneficial grain flow characteristics. Nondestructive inspection as well as detailed microstructure-property correlation must be judiciously used to accept and differentiate the advantages of thick plate products for their proper selection and use for structural applications.
Author (AIAA)
Aluminum Alloys; Thick Plates; Microstructure; Mechanical Properties; Aircraft Parts; Residual Stress

19980070270
Investigation of eddy-current anomalies in welded titanium Ti-6Al-4V
Walker-Heckman, E., McDonnell Douglas Aerospace, USA; Parzuchowski, H. M., McDonnell Douglas Aerospace, USA; 1997, pp. 463-467; In English; Copyright; Avail: Aeroplus Dispatch

Eddy current testing is often used in service to periodically inspect for fatigue cracking in metallic aircraft components. This inspection method was scheduled to be performed in service for several Ti-6Al-4V components that were weld-repaired during the manufacturing process. The location of the weld repair coincided with the location on the component which was scheduled to eventually undergo eddy current inspection measurements in service. In order to determine whether the presence of the weld would affect the in-service inspection, an eddy current evaluation of the weld and the surrounding base metal was performed. During this evaluation, a response was obtained which indicated that a band of material within the weld was higher in conductivity than the remainder of the weld and the base material. An investigation ensued, and it was determined that the response difference was due to the use of an extra-low interstitial weld rod during a portion of the weld repair.
Author (AIAA)
Titanium Alloys; Eddy Currents; Nondestructive Tests; Aircraft Maintenance; Welded Joints

19980070306
Investigating fiber tow crimping effects in braided composite materials
West, A. C., Iowa State Univ., Ames, USA; Adams, D. O., Utah, Univ., Salt Lake City; Experimental Techniques; Oct. 1997; ISSN 0792-8818; Volume 21, no. 3, pp. 15-18; In English; Copyright; Avail: Aeroplus Dispatch

In order to investigate the effect of axial yarn crimping on composite compressive strength, braided composite manels were fabricated with controlled degrees of crimping. Crimping was minimized via whiffle-tree tensioning fixtures during compaction and curing. The axial yarn crimp produced by the conventional high-compaction cure process generated a 30-percent decrease in static compressive strength, relative to the tension-braided case with minimal axial yarn crimp.
AIAA
Braided Composites; Aircraft Structures; Aircraft Construction Materials; Folding; Compressive Strength; Panels

19980071006

Elevated temperature tensile and creep rupture properties of INCONEL Alloy 725

Hibner, Edward L., Inco Alloys International, Inc., USA; Sizek, Howard W., Inco Alloys International, Inc., USA; Mannan, Sarwan K., Inco Alloys International, Inc., USA; 1997, pp. 492-501; In English; Copyright; Avail: Aeroplus Dispatch

INCONEL Alloy 725 is a highly corrosion-resistant nickel-based alloy capable of being age-hardened to high strength levels. In order to determine the potential applicability of Alloy 725 in aircraft gas turbine engines, a research program was undertaken to study the solution-anneal and age-hardening treatments for required elevated temperature properties. This paper presents the microstructure, tensile and creep rupture properties for several heat treatments.
Author (AIAA)
High Temperature Tests; Tensile Tests; Creep Rupture Strength; Inconel (Trademark); Heat Treatment; Aircraft Engines

19980071135

Aging of the Inconel 718 alloy between 500 and 750 C

Slama, C., Paris XI, Univ., France; Servant, C., Paris XI, Univ., France; Cizeron, G., Paris XI, Univ., France; Journal of Materials Research; Sep. 1997; ISSN 0884-2914; Volume 12, no. 9, pp. 2298-2316; In English; Copyright; Avail: Aeroplus Dispatch

The aging of the NC 19 Fe Nb alloy (Inconel 718), previously quenched from 990 C, is characterized by a hardness peak at 650 C, then a maximum in hardness at about 750 C. Over this temperature, the hardness progressively decreases. In the 550-650 C temperature range, TEM observations have revealed that beta (Ni3Nb) precipitates are formed as long platelets parallel between them within the same grain, as well as extremely fine gamma-prime (Ni3(Ti, Al)) particles responsible for the observed improvement in hardness. For a tempering temperature higher than 650 C, a first hardening occurs after a 4-h treatment, which is associated with the gamma-prime phase precipitation, with a more or less spherical shape. Beyond this time, a second hardening takes place linked to the gamma-double-prime phase precipitation (Ni3Nb, bct D022 structure), as thin-platelet-shaped, perfectly coherent with the matrix. The misfit between the gamma and gamma-double-prime phases is about 3 percent in the 001-line gamma-double-prime direction and lower than 1 percent in the 100- and 010-line gamma-double-prime directions. During longer aging at 750 C, the gamma-double-prime platelets progressively dissolve while beta precipitates grow.
Author (AIAA)
Inconel (Trademark); Aging (Metallurgy); Hardness; Temperature Dependence; Turbine Engines; Mechanical Properties

19980072593

Qualification of low-density materials for aircraft sealing and corrosion protection

Bauccio, Michael L., Boeing Co., USA; Aerospace Engineering; Dec. 1997; ISSN 0736-2536; Volume 17,, no. 12, pp. 18, 19; In English; Copyright; Avail: Aeroplus Dispatch

Weight reduction programs have pushed development of low-density polysulfide-based sealants, the newest engineering technology for sealing operations on military and commercial aircraft. Validation of many aircraft sealant properties are needed to ensure consistency of the sealing process and minimize technical risks. Weight savings estimates for low-density sealants on commercial aircraft range from 40-60 lb per airplane. However, there are some production tradeoffs that increase production time when using low-density sealants. Material specifications include engineering requirements for products made by suppliers and ensure that candidate products are tested for qualification by specifying proper testing requirements. The specifications include a listing of vendor materials. In this article, SAE's Aerospace Material Specification (AMS) 3281 (Sealing compound, polysulfide (T) synthetic rubber, for integral fuel tank and fuel cell cavities, low density (1.35 specific gravity maximum), for intermittent use up to 360 F) was used as the engineering baseline for the aircraft manufacturer's material specification. This document allowed the manufacturer efficiently to complete development of a technically accurate material specification for the program. AMS 3281 addresses engineering test requirements for qualification and acceptance of low-density polysulfide sealants. A subset of AMS 3281's engineering requirements was selected for the aircraft program material specification. It is revealed that engineering material test requirements of AMS 3281 helped one aircraft manufacturer prepare a program-unique material specification for qualifi-

cation of two low-density sealants. One sealant was used for two-hour assembly, or squeeze-out time, and the other covered 48-hour assembly.
AIAA
Low Density Materials; Corrosion Prevention; Aircraft Construction Materials; Sealing; Polysulfides; Aircraft Parts

19980072596

Industry takes hard look at fuel flammability

Ponticel, Patrick, USA; Aerospace Engineering; Dec. 1997; ISSN 0736-2536; Volume 17,, no. 12, pp. 44, 45; In English; Copyright; Avail: Aeroplus Dispatch

A special conference on aircraft fuel flammability was held on October 7-9, 1997, in Washington, DC. The Transport Fuel Flammability Conference, conducted jointly by the SAE and the FAA, was held at the request of U.S. Representative James L. Oberstar of Minnesota, a member of the House Aviation Subcommittee. The conference was convened for the purpose of questioning all the old assumptions and all the accepted standards of thinking about center wing fuel tanks. Although the TWA Flight 800 explosion of July 17, 1996, was a major topic of discussion, the objective of the conference was to examine all issues relating to fuel and fuel systems. Those in attendance included representatives from industry, academia, and government. They went into great detail about fuel tank characteristics and the behavior of fuel vapors in tanks. They also explored the feasibility of engineering out possible ignition sources within tanks. Some relevant comments made at the conference are quoted in this article.
AIAA
Aircraft Fuels; Flammability; Aircraft Industry; Fuel Tanks; Passenger Aircraft

19980072861

Analysis of tensile preloaded composites subjected to low-velocity impact loads

Kelkar, Ajit D., North Carolina A & T State Univ., Greensboro, USA; Sankar, J., North Carolina A & T State Univ., Greensboro; Rajeev, K., North Carolina A & T State Univ., Greensboro; Aschenbrenner, Roger J., USAF, Wright Lab., USA; Schoeppner, Gregory, USAF, Wright Lab., USA; 1998, pp. 1978-1987; In English
Report No.(s): AIAA Paper 98-1944; Copyright; Avail: AIAA Dispatch

The progressive damage mechanics of thin and thick tensile preloaded composite laminates subjected to low-velocity impact loads is studied. A finite element model is developed, and the effects of tensile preloads on the impact behavior of composite laminates are analyzed. The impact energy levels required to initiate internal damages in the different thickness laminates if calculated on a per ply basis is found to be almost constant and approximately equal to 0.1 ft/lb. Examination of C-scans of imapcted laminates indicates that the damage areas in the thick laminates are much more extensive than in thin laminates. The duration of impact events in the case of thin laminates is higher than in thick laminates because thick laminates are much stiffer than thin laminates.
AIAA
Carbon Fiber Reinforced Plastics; Impact Loads; Tensile Tests; Aircraft Structures; High Strength; Resin Matrix Composites

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19980049026

A study on the room-temperature curvature shapes of unsymmetric laminates including slippage effects

Cho, Maenghyo, Inha Univ., Republic of Korea; Kim, Min-Ho, Inha Univ., Republic of Korea; Choi, Heung S., Korea Inst. of Aerospace Technology, Republic of Korea; Chung, Chung H., Korea Inst. of Aerospace Technology, Republic of Korea; Ahn, Kyu-Jong, Korea Inst. of Aerospace Technology, Republic of Korea; Eom, Yong S., Lausanne, Ecole Polytechnique Federale, Switzerland; Journal of Composite Materials; 1998; ISSN 0021-9983; Volume 32, no. 5, pp. 460-482; In English; Copyright; Avail: Aeroplus Dispatch

The room-temperature shapes of cured unsymmetric composite laminates have out-of-plane warping after autoclave processing. In addition, they exhibit two stable room-temperature configurations due to snap-through phenomena when the side length of laminates exceed a critical value. The cured shape of unsymmetric laminates are influenced by many factors. Experiments show that the effect of tool-plate cannot be ignored and has significant influence on the cured shape. This study examines slippage effects resulting from the interaction between the laminates and the tool-plate which are ignored in the previous researches. By introduc-

ing a dimensionless slippage coefficient and correlating the corresponding value with experimental results, the influence of processing parameters is investigated. Modeling is extended to predict curvatures of general lamination layup configurations.
Author (AIAA)
Laminates; Surface Geometry; Machine Tools; Aircraft Industry; Autoclaves; Residual Stress

19980049059

The CNS/ATM struggle

Wurdack, Richard L., Boeing Commercial Airplane Group, USA; Alcabin, Monica S., Boeing Commercial Airplane Group, USA; 1998, pp. S3-8 to S3-14; In English; Copyright; Avail: Aeroplus Dispatch

As the aviation industry continues to grow year after year, the strain on the infrastructure and operation of that industry increases. Without significant changes, the capacity of the system will be reached, and availability will no longer be able to meet the anticipated demand. This paper discusses the need to increase that capacity and some of the considerations to be met along the way. There are three primary needs: (1) to treat the problem with a system perspective to minimize suboptimal solutions; (2) to maintain a global perspective in order to develop implementations with the greatest breadth and interoperability; and (3) to rationalize changes economically with the benefits that must be realized so as to fund the necessary changes while avoiding unnecessary expenditures. The viability of the industry depends on delivering value to the customer. The paper discusses the current state of the evolution of the system and the efforts needed to make a rational transition from the existing system to the system of the future.
Author (AIAA)
Air Navigation; Surveillance; Air Traffic Control; Aircraft Communication

19980049404

Effect of scroll wraps on the performance of scroll compressors

Li, Lian-sheng, Xi'an Jiaotong Univ., China; Shu, Peng-cheng; Yu, Yong-zhang; International Journal of Refrigeration; August, 1997; ISSN 0140-7007; Volume 20, no. 5, pp. 326-331; In English; Copyright; Avail: Issuing Activity

A number of geometrical curves have been used to form the wraps of scroll compressors. When the suction pressure, pressure ratio, scroll wrap height and thickness, and suction volume are constant, the effect of the involute curves of a circle, square and line segment on the performances of the scroll compressor, such as geometrical parameters, leakage line length and various gas forces acting on the orbiting scroll are analyzed in this paper. The effects of these scroll wraps on the performance of the scroll compressor vary as the suction volume changes. The results in this paper should be considered in scroll compressor design.
Author (EI)
Compressors; Leakage

19980049516

Experimental simulation of the connection to a ground structure of a downward negative leader ***Simulation experimentale de la connexion d'un leader negatif descendant sur une structure au sol***

Lalande, P., ONERA, France; Bondiou-Clergerie, A., ONERA, France; Laroche, P., ONERA, France; Bonamy, A., Electricite de France, Moret-sur-Loing; Eybert-Berard, A., CEA, Centre d'Etudes Nucleaires de Grenoble, France; Berlandis, J. P., CEA, Centre d'Etudes Nucleaires de Grenoble, France; Bador, P., CEA, Centre d'Etudes Nucleaires de Grenoble, France; Rakov, V., Florida, Univ., Gainesville; Uman, M., Florida, Univ., Gainesville; ONERA, TP no. 1997-75; 1997; In French
Report No.(s): ONERA, TP no. 1997-75; Copyright; Avail: Aeroplus Dispatch

During the summer 1995 CENG, ONERA and EDF performed a campaign of altitude-triggered lightning on the Camp Blanding site in Florida. Using this technique, a negative downward stepped leader was initiated at 450 m above the ground. Its propagation and its connection to a grounded structure of 50 m height were investigated through E-field and current measurements. The measurements were used to study the main chronological sequences involved during cloud to ground lightning.
Author (AIAA)
Lightning; Electric Fields; Electrical Measurement; Aircraft Accidents

19980049646

Research on adaptive vibration control of a smart rotor blade

Ma, Kougen, Nanjing Univ. of Aeronautics and Astronautics, China; Melcher, Joerg, DLR, Inst. fuer Strukturmechanik, Germany; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 633-637; In Chinese; Copyright; Avail: Aeroplus Dispatch

This paper deals with the real-time simulation of smart rotor blade vibration control. A real-time simulation system is constructed. The key units of the system are two Motorola DSP56002EVM boards. One of them is used as a rotor blade dynamics simulator, the other as the controller. In the simulator, two recursive MX-filters are responsible for the responses caused by disturbances and controllers. In the control strategies, adaptive feedforward control and a hybrid control are studied. The hybrid control combines an adaptive feedforward controller with a conventional feedback controller, and can control the modal damping and the responses of smart blades simultaneously. The simulator and the controllers are realized by a special assembly language. Dramatic vibration reductions are obtained for harmonic excitations.

Author (AIAA)

Helicopter Design; Rotor Blades; Vibration Damping; Adaptive Control; Smart Structures

19980049652

Water tunnel experiment of the flowfield in a warship flight deck

Xu, Weiping, Nanjing Univ. of Aeronautics and Astronautics, China; Mei, Weisheng, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Journal; Dec. 1997; ISSN 1005-2615; Volume 29, no. 6, pp. 679-684; In Chinese; Copyright; Avail: Aeroplus Dispatch

An experiment involving the flow field in a warship flight deck area is carried out in a water tunnel for different flow velocities and navigation direction angles. The method used for the experiment is described, and the flow-field pictures are analyzed; a steady zone out of the door of the helicopter hangar is found. This steady zone has a tendency to contract as the flow velocity increases, and it disappears when the flow velocity is higher than a value. There is a turbulent area just behind the steady zone. This area diffuses at its rear part, and its front edge approaches the helicopter hangar as the velocity increases. When the water flows sideward, the flow contracts more. There is no obvious effect on the flow pattern whether the door is opened or closed. When beta is greater than 45 deg, however, the flow field has almost no contraction, and the turbulent area extends into the hangar (if the door is open) or rolled up (if the door is closed).

Author (AIAA)

Water Tunnel Tests; Turbulent Flow; Flow Velocity; Hangars; Flow Geometry

19980049684

Replacing paint with tape films

Ihbe, Tom, USA; Aerospace Engineering; Mar. 1998; ISSN 0736-2536; Volume 18, no. 3, pp. 39, 40; In English; Copyright; Avail: Aeroplus Dispatch

Current developments in the use of tape technology to protect aircraft structures are briefly reviewed. The primary goals are replacing topcoat paint systems on aircraft, using applique technology, and reducing aerodynamic drag. Tape systems for these purposes must have improved performance for any applications to the aircraft, and the systems must have a rugged application process for commercial viability. Current developments concentrate on both materials science and application techniques to achieve these goals.

AIAA

Tapes; Paints; Erosion; Abrasion; Aircraft Structures

19980049685

Plastic media blasting of composite honeycomb sandwich structures

Perl, Douglas R., U.S. Navy, USA; Aerospace Engineering; Mar. 1998; ISSN 0736-2536; Volume 18, no. 3, pp. 40-44; In English; Copyright; Avail: Aeroplus Dispatch

Plastic media blasting (PMB) has gained acceptance for its low impact on the environment. PMB has been approved for paint removal on naval aircraft with metal structures of at least 0.016-in. thickness and monolithic carbon/epoxy laminates of at least 0.073-in. thickness. Here, results of a study to determine the effects of PMB on the microstructure and structural properties of honeycomb sandwich structures consisting of carbon/epoxy face sheets bonded to an aluminum honeycomb core are reported.

AIAA

Composite Structures; Honeycomb Structures; Sandwich Structures; Blasts; Aircraft Structures; Plastics

19980049753

Transient temperature analysis of airplane carbon composite disk brakes

Sahin, Ahmet Z., King Fahd Univ. of Petroleum and Minerals, Saudi Arabia; Al-Garni, Ahmed Z., King Fahd Univ. of Petroleum and Minerals, Saudi Arabia; Journal of Thermophysics and Heat Transfer; Jun. 1998; ISSN 0887-8722; Volume 12, no. 2, pp. 283-285; In English; Copyright; Avail: Aeroplus Dispatch

A numerical analysis of the transient temperature of a multiple carbon-carbon aircraft disk brake system is performed on the basis of temperature-dependent thermophysical properties. It is shown that the specific heat is the main factor affecting the temperature distribution. An assumption of constant thermophysical properties can lead to inaccuracies 20 to 30 percent of the time. The maximum temperatures are obtained around the middle disk and at locations closer to the outer radius. The temperature rise is initially sharp and declines afterward. This is a result of time variations of angular velocity and pressure functions assumed in the analysis. The effect of the convective heat transfer coefficient on the brake temperature variation is negligible.
AIAA
Transient Heating; Carbon-Carbon Composites; Aircraft Brakes

19980049980

Dynamic sensitivity analysis and optimum design of aerospace structures

Gu, Yuanxian, Dalian Univ. of Technology, China; Kang, Zhan, Dalian Univ. of Technology, China; Guan, Zhenqun, Dalian Univ. of Technology, China; Jia, Zhiwen, Dalian Univ. of Technology, China; Structural Engineering and Mechanics; Jan. 1998; ISSN 1225-4568; Volume 6,, no. 1, pp. 31-40; In English; Copyright; Avail: Aeroplus Dispatch

Studies and applications of numerical methods of design optimization on structural dynamic behaviors are presented. The emphasis is on the dynamic design optimization of aerospace structures, particularly those composed of composite laminate and sandwich plates. The methods of design modeling, sensitivity analysis of structural dynamic responses, and optimization solution approaches are presented. Numerical examples of sensitivity analysis and dynamic structural design optimization are given to demonstrate the effectiveness of the numerical methods.
Author (AIAA)
Aircraft Structures; Dynamic Response; Structural Design; Composite Materials

19980050361

Instability of plane compressible gas sheets

Li, X.; Bhunia, A.; Acta Mechanica; 1997; ISSN 0001-5970; Volume 123, no. 1-4, pp. 117-133; In English; Copyright; Avail: Issuing Activity

The instability of a plane compressible gas sheet in a quiescent viscous liquid medium of infinite expanse has been studied. It is found that there exist two unstable modes of disturbances, sinuous and varicose. For temporal instability, sinuous disturbance is stable if the gas Weber number, defined as the ratio of aerodynamic to capillary forces, is less than unity, varicose mode controls the instability process except for large Weber numbers when both modes become equally important, and gas compressibility effect always enhances instability development and induces an additional range of unstable wave numbers. For spatial-temporal evolution of disturbances, it is found that convective instability does not exist at all and the instability of plane gas sheets is always absolute in nature, which is strikingly opposite to the instability of plane liquid sheets. The absolutely unstable disturbance is found always temporally growing, although it may be spatially growing or decaying depending on flow conditions. Gas compressibility always enhances and liquid viscosity damps out both the temporal and the spatial part of absolute instability growth rate. Although the Weber number always promotes the temporal growth rate of absolute instability, it has a dual effect of enhancing and inhibiting the spatial growth rate.
Author (EI)
Viscous Flow; Stability; Bubbles; Aerodynamics; Gas Viscosity

19980050376

Measuring speed and temperature in a large air gap induction motor

Poloujadoff, Michel; Laeuffer, Jacques; Obadia, Jean-Michel; Rezgui, Nadia; IEEE Industry Applications Magazine; November-December, 1997; ISSN 1077-2618; Volume 3, no. 6, pp. 39-42; In English; Copyright; Avail: Issuing Activity

Many methods to estimate the rotor speed have been developed, most are based on the observation of stator currents. Presently, however, stator current do not depend very much on speed. This paper measures speed and temperature of stator currents in a large air gap inductor motor. The measurement is conducted using classical principle. The results obtained are described and the principle is illustrated.
EI
Induction Motors; Temperature Measurement; Mechanical Measurement; Velocity; Rotors; Winding

19980050604

Feasibility of measuring directly distribution of the emissivities for territorial surface on the remote sensing platforms

Zhang, Renhua, Chinese Academy of Sciences, Inst. of Geography, China; Sun, Xiaomin, Chinese Academy of Sciences, Inst. of Geography, China; Zhu, Zhiling, Chinese Academy of Sciences, Inst. of Geography, China; 1997, pp. 168-170; In English; Copyright; Avail: Aeroplus Dispatch

This paper reviews the basic principle of measuring emissivity by using a carbon dioxide laser in 10.6 microns for greater distance. The extension of the technique to determine the 2D distribution of the territorial surface emissivities on airborne or spaceborne platforms is examined.

Author (AIAA)

Remote Sensing; Carbon Dioxide Lasers; Flying Platforms; Surface Temperature; Emissivity

19980050671

Analysis of transient heat transfer in a cylindrical pin fin

Su, Rong-Jia, National Sun Yat-Sen Univ., Taiwan, Province of China; Hwang, Jen-Jyh, National Sun Yat-Sen Univ., Taiwan, Province of China; Journal of Thermophysics and Heat Transfer; Jun. 1998; ISSN 0887-8722; Volume 12, no. 2, pp. 281-283; In English; Copyright; Avail: Aeroplus Dispatch

This study develops analytical solutions for transit heat transfer in a cylindrical pin fin using Laplace transformation and separation of variables methods when the base is subjected to a step change in temperature, and the heat dissipation is convected from the lateral surface and the fin tip to the surroundings in a 2D pin fin. Comparisons of error between the 1D and 2D transient heat flow rate at the base are presented with three tip convective conditions. It is shown via three graphs that the relative errors of the base heat flow between 1D and 2D transient solutions are affected by H for different Bi(a) at G of 10, 5, and 1.

AIAA

Heat Transfer; Fins; Transient Heating

19980050679

Industrial applications of spray technology

Chigier, Norman, Carnegie Mellon Univ., USA; 1997, pp. 227-234; In English; Copyright; Avail: Aeroplus Dispatch

Spray systems are used very extensively in a wide range of industrial applications. Injection of liquid fuel in gasoline and diesel automotive engines, gas turbine aircraft and land-based engines, rocket engines and a wide variety of industrial furnaces and boilers require improved control of atomization and spray characteristics to improve performance and efficiency and to reduce emission of pollutants to satisfy EPA regulations. Spray painting of automobiles, aircraft, bridges and a large range of manufactured products results in the waste of large proportions of paint that does not hit the target and is carried away by offspray, which requires expensive treatment to prevent pollution. In manufacturing processes, molten metal sprays are used for direct manufacture, using near net shaping, high temperature arc spray coatings (thermal spraying), and for coatings. The need to achieve uniform thickness film layers with low porosity requires control of drop size, velocity, temperature, and number density in the spray.

Author (AIAA)

Technology Utilization; Fuel Sprays; Industries; Aircraft Engines; Gas Turbine Engines; Computational Fluid Dynamics

19980050680

Numerical study of two-phase flow field in a simplified swirl cup combustor

Park, Tae W., USAF, Wright Lab., USA; Roquemore, William M., USAF, Wright Lab., USA; Katta, Viswanath R., Innovative Scientific Solutions, Inc., USA; Aggarwal, Suresh K., Illinois, Univ., Chicago; 1997, pp. 215-223; In English; Copyright; Avail: Aeroplus Dispatch

A numerical study was performed to investigate the two-phase flow field in a geometrically simplified swirl cup in a gas turbine combustor. The actual combustor has a hybrid-atomization feature with pressure atomization from the nozzle and airblast reatomization for the liquid film at the tip of the venturi wall. The amount of fuel formed in the venturi tube could play an important role in characterizing the flow field of this combustor. This study investigates the effects of the swirl mode and temperature of the primary and secondary air on the gas-phase flow field, and then the effect of droplet injection characteristics in terms of velocity and location on the droplet transport and vaporization behavior. Detailed plots of droplet trajectory are used to identify the size ranges of the droplets, which can form a liquid film by their impaction on the venturi tube wall. The results indicate that the droplet injection characteristics have a dominant effect on the cut-off droplet diameter for droplet impaction on the venturi wall.

Author (AIAA)

Two Phase Flow; Swirling; Combustion Chambers; Gas Turbine Engines; Fuel Sprays

19980050697

Composite material simulation speeds helicopter development

Forster, Bill, Sikorsky Aircraft, USA; Rogg, Chris, Sikorsky Aircraft, USA; Martin, Randy, Sikorsky Aircraft, USA; Green, Steve, Sikorsky Aircraft, USA; Aerospace Engineering; Mar. 1998; ISSN 0736-2536; Volume 18, no. 3, pp. 29, 30; In English; Copyright; Avail: Aeroplus Dispatch

Sikorsky Aircraft Corp. was able to save four months on the S-92 Helibus helicopter project by simulating composite material performance prior to tooling fabrication. The simulation of the complex composite canopy structure also cut engineering prototyping and tooling costs by reducing the number of revisions required during the tool tryout stage by more than 90 percent. The simulation used the FiberSIM software from Composite Design Technologies to detect wrinkling, bridging, and similar problems during the basic design phase so that they could be corrected before reaching the shop floor.

AIAA

Engineering; Computerized Simulation; Composite Materials; Helicopters

19980050837

Sensorless switched reluctance starter/generator performance

Jones, Stephen R., Sundstrand Aerospace, USA; Drager, Barry T.; IEEE Industry Applications Magazine; November-December, 1997; ISSN 1077-2618; Volume 3, no. 6, pp. 33-38; In English; Copyright; Avail: Issuing Activity

The performance of a high-speed switched reluctance starter/generator system operating sensorless with an electronic rotor position estimation subsystem is compared to system performance when operating with a resolver. Data obtained for both start and generate modes of operation show minimal differences in system efficiency and transient performance between the two approaches. Thus, the data indicate that the electronic position sensing subsystem is performing satisfactorily in terms of preserving overall system efficiency at those speeds, loads, and transient conditions.

EI

Digital Systems; Position Sensing; Reluctance; Electric Generators; Starters; Rotors; Winding; Positioning

19980051506

Effect of ice clouds on millimetre-wave aeronautical and satellite communications

Papatsoris, A. D.; Electronics Letters; Oct 09, 1997; ISSN 0013-5194; Volume 33, no. 21, pp. 1766-1768; In English; Copyright; Avail: Issuing Activity

Recent propagation experiments in the Ka-band have shown that cross-polarization discrimination is poorly predicted, mainly due to inadequate modelling of the effects of ice clouds. Ice cloud depolarization is investigated at millimetre wavelengths and the implications in aeronautical and satellite communication systems are discussed.

Author (EI)

Aeronautical Satellites; Aircraft Communication; Ice Clouds; Millimeter Waves; Satellite Communication; Radio Transmission; Electromagnetic Wave Transmission; Polarization (Waves)

19980051711

Sandwich construction

Hoff, N. J., Brooklyn, USA; Mautner, S. E.; Structures technology - Historical perspective and evolution; 1998, pp. 239-255; In English; Copyright; Avail: Aeroplus Dispatch

This paper, published in 1944, reviews the history and the current status of sandwich structures consisting of high-strength load-carrying skin layers with a low-weight spacer enclosed between the skins. The materials then available for the skin layers were plywood, wood pulp fibers, and aluminum alloys; materials used for the core were cork, balsa wood, and synthetic materials, such as cellulose acetate. The discussion focuses on various tests to determine the strength and stiffness of the sandwich skins, comparison of sandwich structures with aluminum alloys, and design and manufacture of sandwich structures.

AIAA

Sandwich Structures; Skin (Structural Member); Monocoque Structures; Aircraft Structures; Tensile Tests; Torsion

19980051712

Integrally stiffened structures

Sandorff, Paul, Lockheed Aircraft Corp., USA; Papen, G. W., Lockheed Aircraft Corp., USA; Structures technology - Historical perspective and evolution; 1998, pp. 219-237; In English; Copyright; Avail: Aeroplus Dispatch

The advantages and applications of integrally stiffened aircraft structures, as opposed to conventional skin-and-stiffener structures, are reviewed. In particular, attention is given to the functional aspects of aircraft structures, inherent disadvantages of

conventional construction, and recent advances in solving structural problems through the use tapered sheet, tapered extrusion, tailored sheet, and integrally stiffened structures. Further developments are discussed with emphasis on reducing raw material cost and speeding up the machining process.
AIAA
Stiffening; Aircraft Structures

19980051714

The cautious course to introducing new SDM technology into production systems

Hadcock, Richard N., Grumman Aerospace Corp., USA; Structures technology - Historical perspective and evolution; 1998, pp. 191-194; In English; Copyright; Avail: Aeroplus Dispatch

Due to advances in new structures, structural dynamics, and materials (SDM) technology, the next generation of military aircraft, commercial aircraft, helicopters, and spacecraft should enjoy the benefits of lower procurement and operating costs, lower weight, and, in some cases, aeroelastic tailoring. Here, advances in SDM technology over the past 50 years, which led to major improvements in structural efficiency, durability, and cost effectiveness, are briefly reviewed, with particular attention given to the development of advanced composites and advanced metallic structures. Factors that have to be considered when introducing new SDM technology are discussed.
AIAA
Dynamic Structural Analysis; Supersonic Speed; Military Aircraft; Commercial Aircraft

19980051721

Structures and subsystems

Taylor, Allan H., NASA Langley Research Center, USA; MacConochie, I. O., NASA Langley Research Center, USA; Jackson, L. R., NASA Langley Research Center, USA; Martin, J. A., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 145-155; In English; Copyright; Avail: Aeroplus Dispatch

New materials and novel designs that are being studied to identify technologies needed for a low-cost future space transportation system (FSTS) are examined. The discussion covers structural goals and concepts, wall constructions, primary structures, concept comparisons, and technology requirements. The subsystems discussed include propulsion, prime power distribution, life support and environmental conditioning, centralized fuel management, and avionics.
AIAA
Spacecraft Structures; Space Transportation System; Airframes; Thermal Protection

19980051725

Trends in aerospace structures

Card, Michael F., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 121-133; In English; Copyright; Avail: Aeroplus Dispatch

The state-of-the-art in aerospace structures in the late 1970s and the developments anticipated for the next two decades are reviewed. In particular, attention is given to prospects for substantial weight savings, preliminary design tools to exploit performance benefits, design-to-cost technologies, impact of the energy crisis on structures, and spinoff of aerospace technologies. The discussion also covers loads analysis methods, structural concepts, structural analysis methods, and testing.
AIAA
Aircraft Structures; Weight Reduction; Aluminum Alloys; Adhesive Bonding; Fiber Composites; Structural Design

19980051731

Developing structures technology for the day after tomorrow

Brooks, George W., NASA Langley Research Center, USA; Structures technology - Historical perspective and evolution; 1998, pp. 33-49; In English; Copyright; Avail: Aeroplus Dispatch

Some highlights of the NASA's airframe structures program in early 1970s are examined. The principal goals of the program were developing automatic analysis and design, building confidence in advanced composites, improving the technology base for future supersonic and hypersonic vehicles, validating concepts for active control, developing methods for predicting aircraft loads and aeroelasticity, and generating design methods for assuring structural integrity.
AIAA
Aircraft Structures; Airframes; Impingement; Unsteady Flow; Aeroelasticity; Supersonic Aircraft

19980051732

New era dawns for flight materials and structures

Gerard, George, New York Univ., USA; Structures technology - Historical perspective and evolution; 1998, pp. 27-30; In English; Copyright; Avail: Aeroplus Dispatch

The problems of materials and structures that had to be solved at the dawn of the space era are briefly examined with emphasis on the thermal protection of boost-glide vehicles against the effects of steady-state heating. Two distinct aspects of the boost-glide class of vehicles are considered: the problem of the leading-edge structure, which may be subject to stagnation temperatures of the order of 3000 F, and the problem of the load-carrying structure, for which the maximum equilibrium temperatures are of the order of 2000 F. Developments in the area of heat-sustaining (e.g., graphite, ceramics, and coated molybdenum) and heat-absorbing (e.g., beryllium, graphite, reinforced plastic, and ceramics) materials are discussed, as are advances in thermal protection techniques.

AIAA

Ballistic Missiles; Hypervelocity Flow; Reentry; Aerodynamic Heating; Structural Design; Thermal Protection

19980051736

Structures technology - Historical perspective and evolution

1998; In English; ISBN 1-56347-116-7; Copyright; Avail: Aeroplus Dispatch

This selection of articles published in Aerospace America and its predecessors over the past forty years provides a historical perspective on the development of structures technology in the aerospace industry. After an overview of structures technology in general and aircraft and space structures technology in particular, attention is given to special structures for aircraft and spacecraft. In particular, the discussion focuses on structural configurations, thermal protection systems, and structures for supersonic and hypersonic vehicles. Some specific topics discussed include integrally stiffened structures; the Shuttle tile story; large vehicle concepts; design of airframes for nuclear power; developing HST structural technology; structures and materials in the long-duration manned spacecraft; and a new cryogenic storage system for spacecraft.

AIAA

Conferences; Spacecraft Structures; Aircraft Structures

19980051798

Object-oriented implementation of expert systems for engine lubricating oil inspection

Yang, Zhong, Nanjing Univ. of Aeronautics and Astronautics, China; Zuo, Hongfu, Nanjing Univ. of Aeronautics and Astronautics, China; Liu, Zhengxun, Nanjing Univ. of Aeronautics and Astronautics, China; Gan, Minliang, Nanjing Univ. of Aeronautics and Astronautics, China; Wu, Huixiang, Nanjing Univ. of Aeronautics and Astronautics, China; Nanjing University of Aeronautics & Astronautics, Transactions; Dec. 1997; ISSN 1005-1120; Volume 14, no. 2, pp. 170-176; In English; Copyright; Avail: Aeroplus Dispatch

Inspection of the engine lubricating oil can give an indication of the internal condition of an engine. by means of object-oriented programming (OOP), an expert system is developed in this paper to computerize the inspection. The traditional components of an expert system, such as the knowledge base, the inference engine, and the user interface are reconstructed and integrated, based on the Microsoft Foundation Class (MFC) library. to verify the expert system, an inspection example is given at the end of this paper.

AIAA

Object-Oriented Programming; Expert Systems; Lubricating Oils; Inspection; Aircraft Engines; Computer Systems Design

19980051921

In situ crack propagation monitoring in aerospace structures by digital sensor

Marchetti, M., Roma I, Univ., Italy; Pisciolini, G., Roma I, Univ., Italy; 1997, pp. 169-182; In English; Copyright; Avail: Aeroplus Dispatch

This paper develops a passive system sensor in order to analyze the rise and behavior of crack propagation coming to the surface in plane structural elements. The main feature of this system is to monitor the condition of the residual reliability of the structural element following progressive damage, in situ and in the normal load condition which it has to provide. The sensor is made by a film which supports a grid row-column of electric conductors which will be subsequently attached on the surface of the structural object. The propagation of the defect is observed, with the progressive interruption of the electric contact on the surface row-column of the grid.

Author (AIAA)

Crack Propagation; In Situ Measurement; Spacecraft Structures; Aircraft Structures; Sensors; Digital Systems

19980051942

Non-linear analysis of the effect of support construction properties on the dynamic properties of multi-support rotor systems

Kicinski, J., Polish Acad. of Sciences, Poland; Drozdowski, R.; Materny, P.; Journal of Sound and Vibration; Oct 02, 1997; ISSN 0022-460X; Volume 206, no. 4, pp. 523-539; In English; Copyright; Avail: Issuing Activity

The paper reports on the course of simulation research of large rotor machines (200 MW power turbine sets) carried out at the Institute of Fluid-Flow Machinery, Polish Academy of Sciences (IFFM PAS). The investigations draw on a non-linear theoretical model and a developed computer code. The paper presents the main assumptions of this model and examples of its experimental verification. An attempt is made to classify the hydrodynamic instability of the system, in a diagnostic manner. The analysis of dynamic properties of a 200 MW turbo-set is concentrated on two selected problems, the first of which is the effect of thermo-elastic deformation of the bearing bushes on the lateral forced vibration of the rotor line system. The simulation research is conducted on the basis of a three-dimensional elastodiathermal model of the bearing nodes. This enables the modelling of complex processes of heat transfer in the bearing, as well as the validation of arbitrary methods of fixing and action areas of the initial clamping forces. The second problem is the analysis, based on the finite element method, of dynamic properties of the LP casing at the fixing points of the bearing bushes.

Author (EI)

Dynamic Characteristics; Support Systems; Rotors; Turbomachinery; Vibration; Mathematical Models; Computer Programs

19980052532

New structures for new aerospace systems

Noor, Ahmed K., NASA Langley Research Center, USA; Venneri, Samuel L., NASA, USA; Paul, Donald B., USAF, Research Lab., USA; Chang, James C. I., USAF, Office of Scientific Research, USA; Structures technology - Historical perspective and evolution; 1998, pp. 3-10; In English; Copyright; Avail: Aeroplus Dispatch

Advances in computational structures technology and composite materials will enable breakthroughs in vehicle performance while reducing cost and development time. Some of the recent developments in structures technology are briefly reviewed, with particular attention given to smart materials and structures, multifunctional structures, affordable composite structures, extreme environmental structures, flexible load-bearing structures, computational methods, and simulation-based design. Finally, some future directions in the area of structures technology are outlined.

AIAA

Smart Materials; Aircraft Structures; Composite Structures; Flexible Bodies

19980052800

Displacement effect in Pitot tube measurements in shear flows

Raju, K. G. Ranga, Univ. of Roorkee, India; Porey, P. D.; Asawa, G. L.; Journal of Wind Engineering and Industrial Aerodynamics; Feb, 1997; ISSN 0167-6105; Volume 66, no. 2, pp. 95-105; In English; Copyright; Avail: Issuing Activity

Measurements of velocities in the boundary layer of a wind tunnel using square-nosed, round and elliptical Pitot tubes of different sizes are reported. The displacement of the effective centre from the geometric centre of the Pitot tube is found to be different from those given by some of the available relationships. A simple model has been developed for the functional form of the correction for the displacement effect and all available data on square-nosed Pitot tubes used to arrive at a method of correcting for the displacement effect in case of Pitot tube measurements in shear flows.

Author (EI)

Pitot Tubes; Shear Flow; Flow Measurement; Velocity Measurement; Boundary Layers; Wind Tunnels

19980052801

Numerical study of a linear shear flow past a rotating cylinder

Chew, Y. T., Natl. Univ. of Singapore, Singapore; Luo, S. C.; Cheng, M.; Journal of Wind Engineering and Industrial Aerodynamics; Feb, 1997; ISSN 0167-6105; Volume 66, no. 2, pp. 107-125; In English; Copyright; Avail: Issuing Activity

The effects of shear rate on flow past a rotating circular cylinder in a linear shear flow have been investigated by using a hybrid vortex method at a Reynolds number of 1000. The velocity gradient of the shear flow K ranges from - 0.3 to 0.3 and the rotational to translational speed ratio alpha is 0.5. The results show that the form of vortex shedding is controlled by the shear parameter K. The drag coefficient decreases with increasing (vertical bar) K(vertical bar). On the other ha, the lift coefficient and Strouhal

number increase as K increases. As K increases, the separation positions shift downstream, the wake becomes narrower and the amplitude of fluctuation of the instantaneous lift and drag coefficients decreases.
Author (EI)
Aerodynamic Coefficients; Aerodynamic Drag; Rotating Cylinders; Shear Flow; Strouhal Number; Aerodynamics; Numerical Analysis; Cylindrical Bodies; Vortices

19980052802

Experimental investigation of flow fields downstream of solid and porous fences

Yaragal, Subhas C., Indian Inst. of Science, India; Ram, H. S. Govinda; Murthy, K. Keshava; Journal of Wind Engineering and Industrial Aerodynamics; Feb, 1997; ISSN 0167-6105; Volume 66, no. 2, pp. 127-140; In English; Copyright; Avail: Issuing Activity

Wind tunnel experiments were conducted under highly turbulent and disturbed flow conditions over a bluff/porous plate with a long splitter plate in its plane of symmetry. The effect of plate porosity on fluctuating pressures measured across and along the separation bubble was studied. In addition to fluctuating pressures, mean-velocity measurements and surface mean-pressure distributions were measured after preliminary flow visualization studies. The Reynolds number based on the width of the two-dimensional body was 2.4 x 10(sup 4). Mean pressures were found to be strongly dependent on porosity. The study also showed that both at the surface and within the flow, the fluctuating pressures showed significant dependence on the porosity of the forebody. A 60% porous fence was found to reduce the fluctuating pressures in the flow field by about 50% in contrast to a solid fence. The results presented in this paper are a part of an ongoing experimental investigation undertaken on solid and porous fences.
Author (EI)
Flow Distribution; Aerodynamics; Turbulent Flow; Solids; Porous Materials; Wind Tunnels

19980053967

Rotor design and optimization in internal lobe pumps

Mimmi, Giovanni, Universita degli studi di Pavia, Italy; Pennacchi, Paolo; Applied Mechanics Reviews; Nov, 1997; ISSN 0003-6900; Volume 50, no. 11 pt 2, pp. S133-S141; In English; 1997 5th Pan-American Congress of Applied Mechanics, Jan. 2-4, 1997, San Juan, PR, USA; Copyright; Avail: Issuing Activity

The topic of this paper is the design of internal lobe pumps and their optimization which is based on specific performance indexes. Internal lobe pumps can be classified as different types depending on the shape of the lobe of the outer rotor. First, the design of internal lobe pumps with elliptical, sinusoidal, and polycircular lobe profiles is considered. The latter is a new type of lobe profile with special shape whose curvature follows a definite function. Then we introduce the performance indexes used for the comparison. Some of these indexes, such as the flow rate irregularity, are commonly used for performance comparison, while others, such as the specific slipping and the rotor curvature, are particularly suitable in this case. The comparisons are made with the circular type that had been analyzed by the authors in previous papers. It is not easy to univocally state the superiority of one type with respect to the others, however, it is possible to notice that elliptical and polycircular types are comparable to the circular ones in terms of flow rate irregularity, but have improved performance in terms of specific slipping and rotor curvature.
Author (EI)
Pumps; Rotors; Optimization

19980054269

Diagnosis and condition monitoring of medium-speed marine diesel engines

Kouremenos, D. A., Natl. Technical Univ. of Athens, Greece; Hountalas, D. T.; TriboTest; Sep, 1997; ISSN 1354-4063; Volume 4, no. 1, pp. 63-91; In English; Copyright; Avail: Issuing Activity

Diagnosis of diesel engines is not new and various methods have been proposed in the past for fault diagnosis. The problems relating to marine diesel engines, especially medium- and high-speed engines, are due mainly to their large size, which does not allow the use of trial and error methods, and their high operating speed. The most difficult problem occurs when the engine is not able to produce its maximum power, while there is no obvious fault or error. In the present work a method is described which attempts to offer a solution to such problems. The method is a thermodynamic one based on a simulation model and the processing of measured engine data. Presented is an application of the method to a medium-speed marine diesel engine, which suffered from low power output accompanied by high exhaust gas temperatures. The results from application of the method show that the problem is not a direct one, but is caused by many factors that result in improper operation. With this method, the current engine condi-

tion can be discovered, and suggestions made for proper tuning or repair. After conducting such an analysis, a vessel was able to achieve its maximum cruising speed, showing that the proposed method is a promising one.
EI
Diesel Engines; Gas Turbine Engines; Marine Propulsion; Tribology; Thermodynamics

19980054492
On the stability of an equilibrium position and rotational motion of a gyrostat
El-Gohary, A. I., Mansoura Univ., Egypt; Mechanics Research Communications; Jul-Aug, 1997; ISSN 0093-6413; Volume 24, no. 4, pp. 457-462; In English; Copyright; Avail: Issuing Activity

This article is devoted to study the compulsory stability of equilibrium position and rotational motion of a rigid body containing fluid with the help of three rotors carried on the body. The control moments on the rotors using that condition which impose the stabilization of equilibrium position of the rigid body and rotational motion are obtained.
Author (EI)
Stabilization; Rotation; Rotors

19980054492
On the stability of an equilibrium position and rotational motion of a gyrostat
El-Gohary, A. I., Mansoura Univ., Egypt; Mechanics Research Communications; Jul-Aug, 1997; ISSN 0093-6413; Volume 24, no. 4, pp. 457-462; In English; Copyright; Avail: Issuing Activity

This article is devoted to study the compulsory stability of equilibrium position and rotational motion of a rigid body containing fluid with the help of three rotors carried on the body. The control moments on the rotors using that condition which impose the stabilization of equilibrium position of the rigid body and rotational motion are obtained.
Author (EI)
Stabilization; Rotation; Rotors

19980054640
New in technology
Journal of Applied Fire Science; 1997; ISSN 0735-6331; Volume 6, no. 3, pp. 295-303; In English; Copyright; Avail: Issuing Activity

Beele Engineering B.V. of Aalten, the Netherlands has developed and introduced a new type of luminescent and temperature-resistant rubber. Through an exclusive patent licensing agreement with NASA, a company in Buffalo, New York, will manufacture and market a fire imager device that will aid firefighters to see invisible flames and help them navigate through smoky buildings. Cerberus Pyrotronics of Cedar Knolls, New Jersey, announced today that its World Wide Web site will be available on the Internet (http://www.cerbpyro.com). Pierce Manufacturing Inc. has upgraded its 100-foot aerial platform so it now provides a 22-square-foot basket, with more working room than any other basket available to the industry. Pierce Manufacturing Inc. created its site on the World Wide Web this winter to foster two-way communication with its fire fighting customers, the majority of whom are already using the Internet to find information regarding fire fighting and equipment.
Author (revised by EI)
Flying Platforms; Fire Fighting; Fires; Rubber; Thermodynamic Properties; Computer Networks

19980054779
Fracture mechanics of plates and shells applied to fail-safe analysis of fuselage. Part II: computational results
Huang, N. C., Univ. of Notre Dame, USA; Li, Y. C.; Russell, S. G.; Theoretical and Applied Fracture Mechanics; Aug, 1997; ISSN 0167-8442; Volume 27, no. 3, pp. 237-253; In English; Copyright; Avail: Issuing Activity

In this paper, the problem of the fracture of a fuselage stiffened by longitudinal longerons and circumferential frames is analyzed by means of the finite element method. Our research is motivated by the fail-safety design concept of fuselage for civil aircraft. In this study, the total energy release rate are evaluated for five types of basic loading, namely, axial extension, pure bending, twisting, transverse shearing, and radial expansion due to internal pressure. The crack is located either at the mid-point or near the end of the fuselage. It extends in two bays with the stiffener at its center. The stiffener which bisects the crack is assumed to be broken at the location of the crack. Computational results indicate that the total energy release rate G(sub t) increases with the increasing crack length. However, when the crack tip approaches the stiffener, the value of G(sub t) decreases as a result of the reinforcement from the stiffener. For a crack near the end of the fuselage, as a result of boundary effect, the value of G(sub t) is larger in comparison with the case of the crack at the mid-point of the fuselage. We also find that the effect of geometrical nonlinearity can reduce the value of G(sub t) for the fuselage under axial tension or pure bending. For the fractured fuselage under pure

bending, shell buckling can occur at the concave side of the fuselage prior to crack growth. The maximum tensile stress in the stiffener in front of the crack tip is also investigated.
Author (EI)
Crack Tips; Fail-Safe Systems; Fracture Mechanics; Fuselages; Plates (Structural Members); Shells (Structural Forms); Cracks

19980055230

Finite element analysis of compressible and incompressible viscous flows

Nonaka, N., Chuo Univ., Japan; Nakayama, T., Chuo Univ., Japan; 1998, pp. 46-51; In English; Copyright; Avail: Aeroplus Dispatch

A new unified numerical method based on the FEM is presented for the analysis of both compressible and incompressible 2D flows. The governing flow equations are the equation of continuity, the compressible Navier-Stokes equations, and the energy equation expressed in terms of pressure, and the primary unknown variables are velocity, pressure, and density. The primary variables are integrated in time by the two-stage scheme. In the first stage, the interim values of the variables are calculated by solving the flow equations without advection terms. In the second stage, those interim values are corrected by adding advective effects through the solution of the pure advection equation of each primary variable. The equations solved in the first stage are discretized by the FEM in space. For the numerical computation of pure advection equations in the second stage, a new upwind scheme based on the method of characteristic lines is devised. The proposed method has been tested through two numerical examples: the transonic flow around an airfoil and the viscous incompressible flow in a lid-driven cavity. Accurate and stable computations have been attained.
Author (AIAA)
Compressible Flow; Finite Element Method; Incompressible Flow; Finite Volume Method; Viscous Flow; Airfoil Profiles

19980055283

An optimal fluid force control with velocity in convection dominated flow

Maruoka, A., Chuo Univ., Japan; Kawahara, M., Chuo Univ., Japan; 1998, pp. 542-547; In English; Copyright; Avail: Aeroplus Dispatch

A formulation in which optimal control in convection-dominated flow is applied to a fluid force reduction problem is presented. The external flow around a body with an artificial boundary approximation is treated, and the fluid force is induced by the vortex shedding on the body. The incompressible Navier-Stokes equations are used for the governing equations in the convection dominated flow. Adjoint equations are derived for obtaining the gradient of the cost function. As a numerical example, the present control problem is applied to a lift force reduction problem of the flow past a circular cylinder at Reynolds number 100.
Author (AIAA)
Convective Flow; Optimal Control; Vortex Shedding; Aerodynamic Forces; Lift

19980055377

Modeling of microcrack damaged composite plates undergoing nonlinear bimodular flutter oscillations

Kim, Taehyoun, Georgia Inst. of Technology, Atlanta, USA; Atluri, Satya N., Georgia Inst. of Technology, Atlanta; Loewy, Robert G., Georgia Inst. of Technology, Atlanta; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 598-606; In English; Copyright; Avail: Aeroplus Dispatch

Numerical methods to investigate the flutter response and aeroelastic stability of plates made of composite materials, wherein microcracking occurs in the matrix material, are presented. The analytical modeling of the modulus reduction due to microcracks is based on a self-consistent method with a two-phase model and yields reduced moduli of the composites as functions of the crack density distribution. Both a finite difference and a finite element formulation are presented for two-dimensional laminated plates in supersonic flow. From the numerical results, it is shown that the microcracking in composites results in a loss of aeroelastic stability through nonlinear bimodular oscillation as well as by a direct reduction in the bending stiffness. For three-dimensional flutter problems, however, reduction in the torsional rigidity and changes in elastic couplings may further decrease the stability.
Author (AIAA)
Microcracks; Aeroelasticity; Composite Materials; Plates (Structural Members); Supersonic Flutter; Free Vibration

19980055387

Aeroelasticity of laminated fiber-reinforced doubly curved shallow shells

Bismarck-Nasr, Maher N., Inst. Tecnologico de Aeronautica, Brazil; AIAA Journal; Apr. 1998; ISSN 0001-1452; Volume 36, no. 4, pp. 661-663; In English; Copyright; Avail: Aeroplus Dispatch

A two-field variable variational formulation is introduced for the analysis of fiber-reinforced doubly curved shallow shells subjected to nonconservative aerodynamic loads. It is shown that the functional presented here has no explicit material bending-extensional coupling terms. These effects appear only in the equivalent material bending stiffness constitutive constants. A solution is obtained by using a C1 continuity finite element method.
AIAA
Aeroelasticity; Shallow Shells; Fiber Composites; Curves (Geometry); Laminates

19980055423

The effects of small-scale surface roughness on laminar airfoil-scale trailing edge separation bubbles

Huebsch, W. W., Iowa State Univ., Ames, USA; Rothmayer, A. P., Iowa State Univ., Ames; Jan. 1998; In English
Contract(s)/Grant(s): F49620-95-1-0275; NGT3-52332
Report No.(s): AIAA Paper 98-0103; Copyright; Avail: Aeroplus Dispatch

An interacting boundary-layer algorithm is used to investigate the effects of small-scale surface roughness on airfoil-scale laminar separation bubbles. Steady, laminar trailing-edge separation bubbles are computed for two-dimensional flow past a symmetric biconvex airfoil. Results from this work show that small-scale roughness configurations can significantly alter the characteristics of a laminar separation bubble in low speed flows.
Author (AIAA)
Laminar Flow Airfoils; Surface Roughness Effects; Trailing Edges; Boundary Layer Separation; Bubbles

19980055471

Large eddy simulations of two-phase turbulent flows

Pannala, S., Georgia Inst. of Technology, Atlanta, USA; Menon, S., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Contract(s)/Grant(s): DAAH04-96-1-0008; F49620-95-C-0080
Report No.(s): AIAA Paper 98-0163; Copyright; Avail: Aeroplus Dispatch

A two-phase subgrid combustion model has been developed for large-eddy simulations (LES). This approach includes a more fundamental treatment of the effects of the final stages of droplet vaporization, molecular diffusion, chemical reactions, and small-scale turbulent mixing than other LES closure techniques. As a result, Reynolds, Schmidt, and Damkohler number effects are explicitly included. This model has been implemented within an Eulerian-Lagrangian two-phase formulation. In this approach, the liquid droplets are tracked using the Lagrangian approach up to a prespecified cut-off size. The evaporation of the droplets larger than the cut-off size and the evaporation and mixing of droplets smaller than the cut-off size are modeled within the subgrid using a Eulerian two-phase model. It is shown that droplets with order unity Stokes number disperse more than small droplets, in agreement with earlier numerical and experimental studies. Conventional and the present approach agree very well when droplets do not fall below the cut-off. However, the present approach gives consistently better results when the cut-off is increased, thereby, demonstrating an important advantage of the new method.
Author (AIAA)
Large Eddy Simulation; Two Phase Flow; Turbulent Flow; Fuel Combustion; Gas Turbine Engines

19980055511

Recent developments on the conservation property of Chimera

Wang, Z. J., CFD Research Corp., USA; Hariharan, Nathan, CFD Research Corp., USA; Chen, Rangfu, CFD Research Corp., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0216; Copyright; Avail: Aeroplus Dispatch

An estimate on the conservation error due to the nonconservative data interpolation scheme for overset grids is given. It is shown that the conservation error is a first-order term if second-order conservative schemes are employed for the Chimera grids and if discontinuities are located away from overlapped grid interfaces. Therefore, in the limit of global grid refinement, valid numerical solutions should be obtained with a data interpolation scheme. The conservation error in the original Chimera scheme is also shown to affect flows even without discontinuities on coarse to medium grids. The conservative Chimera scheme has been shown to give significantly better solutions than the original Chimera scheme on these grids with other factors being exactly the same.
Author (AIAA)
Computational Grids; Conservation; Computational Fluid Dynamics; Error Analysis; Turbulent Flow; Airfoil Profiles

19980055518

Recent advances in theoretical methods for laminar-turbulent transition prediction

Arnal, D., ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Gasparian, G., ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Salinas, H., ONERA, Centre d'Etudes et de Recherches de Toulouse, France; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0223; Copyright; Avail: Aeroplus Dispatch

This paper gives examples of application on transition prediction methods based on stability theory, both linear and nonlinear. The numerical results are compared with low speed experiments performed on a swept-wing equipped with a suction system. A first series of computations is performed by using the classical e exp N method based on local approach, and the problem of N factor integration strategy is addressed. The differences between linear, local and nonlocal results are then discussed. The last part of the paper is devoted to investigations of possible nonlinear mechanisms occurring on a swept wing with and without suction.
Author (AIAA)

Transition Flow; Prediction Analysis Techniques; Aerodynamics; Computational Fluid Dynamics

19980055577

Commercial devices in space-single event effects on Earth

Fogarty, T. N., Prairie View A & M Univ., USA; You, Z., Prairie View A & M Univ., USA; Attia, J., Prairie View A & M Univ., USA; Wilkins, R., Prairie View A & M Univ., USA; Washington, K., Prairie View A & M Univ., USA; Kouba, C., NASA Johnson Space Center, USA; Lawton, R.; Jan. 1998; In English

Contract(s)/Grant(s): NCCW-0086; NCC9-50
Report No.(s): AIAA Paper 98-0296; Copyright; Avail: Aeroplus Dispatch

The NASA-PVAMU Center for Applied Radiation Research (CARR) is evaluating the parallel trends towards increased device susceptibility to single-event effects and toward the application of commercial new technology semiconductor devices to space systems as well as airborne avionics. This effort is directed toward in situ test programs, testing and analysis of commercial devices, establishing an electronic dialog among leaders in the field and simulation of basic circuit design solutions that could be applied commercially. Economic considerations and the desire for state-of-the-art functionality are prime drivers toward the use of commercial-grade devices for space and airborne systems. As device geometry shrinks, the specific capacitance decreases and thus the critical charge for a single event effect is reduced. Therefore, it is expected that single event effects will become an important problem in terrestrial environment applications of the commercial devices. CARR is establishing an electronic dialog covering the converging needs of the above commercial applications.
Author (AIAA)

Single Event Upsets; Semiconductor Devices; Avionics; Spacecraft Electronic Equipment; Network Synthesis; Radiation Hardening

19980055594

Leading edge vortex and shear layer instabilities

Ng, T. T., Toledo, Univ., USA; Oliver, Doug R., Toledo, Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0313; Copyright; Avail: Aeroplus Dispatch

The stability of a leading edge vortex was studied using flow visualization and velocity data. The development of a vortex can be envisioned as composed of three possible stages. During the initial stage, the shear layer and its associated vorticity immediately downstream from the apex coalesce to form a primary vortex core; the vortex flow resembles a forced vortex. When the primary core is sufficiently developed, the secondary vortex becomes a prominent perturbation along the leading edge. The induced cross flow instability leads to the formation of stable, corotating, streamwise vortex filaments in the separated shear layer. A second stage occurs where the straining field of the main vortex amplifies the secondary instability near the saddle point between a corotating shear layer vortex pair. This leads eventually to the formation of a secondary vortex core consisting of a series of vortices with an opposite sense of rotation to the primary core. Such a vortex system violates the circulation distribution criterion for helical flow stability, and the vortex becomes centrifugally unstable. If the growth rate of the instability is sufficiently fast relative to the convection rate, a third stage occurs whose result is an expansion of the vortex cross-section or vortex breakdown, with the circulation eventually reestablishing a stable distribution.
Author (AIAA)

Leading Edges; Vortex Breakdown; Shear Layers; Flow Visualization; Aerodynamic Stability

19980055634

Computer simulation of aircraft and automobile behavior upon water impact

Winn, Robert C., Engineering Systems, Inc., USA; Kohlman, David L., Engineering Systems, Inc., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0358; Copyright; Avail: Aeroplus Dispatch

This paper presents the results of a computer simulation that predicts the dynamics of a vehicle as it enters the water, floats, and perhaps sinks. The program simulates the behavior of an automobile or aircraft hitting the surface of a body of water gives results that qualitatively match recorded behavior. The program provides an insight into the time histories of the loading on the vehicle. In particular, the peak loading that occurs in the first few milliseconds of the accident is predicted. The program also predicts the movement and orientation of the vehicle from first impact through sinking to the bottom of the body of water. The paper describes the methodology used in simulating the event, and presents results of several simulations. The program is shown to be a valuable tool in reconstructing accidents in which aircraft or automobiles impact the surface of a body of water.
Author (AIAA)

Computerized Simulation; Aircraft Models; Automobiles; Dynamic Characteristics; Fluid-Solid Interactions; Ditching (Landing); Accidents; Accident Investigation

19980055663

Broadband infrared sensor for active control of high pressure combustors

Seitzman, J. M., Georgia Inst. of Technology, Atlanta, USA; Tamma, R., Georgia Inst. of Technology, Atlanta; Scully, B. T., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0401; Copyright; Avail: Aeroplus Dispatch

A sensor approach for monitoring water mole fraction and temperature uniformity in the exit plane of a high pressure gas turbine combustor is presented. The sensor, intended for use in an active-control system, is besed on IR line-of-sight absorption measurements of water with a relatively broadband light source. Performance of the sensor was simulated using a computer model based on the HITRAN/HITEMP database for the IR absorption of water. Specific regions of interest near 2.5 microns were identified, based on their relative sensitivity to temperature. One region is relatively insensitive to temperature and permits monitoring of integrated water mole fraction across the exhaust. Two wavelengths, one with positive slope sensitivity and the other negative, are used to monitor the uniformity of the exhaust temperature profile. The linearity and sensitivity of the approach to uncertainties in the spectral shape and width, and the wavelength of the filtered light source, are also presented.
Author (AIAA)

Broadband; Infrared Detectors; Active Control; Combustion Chambers; High Pressure; Gas Turbine Engines

19980055690

On the drag of two-dimensional flow about a normal flat plate

Wen, Chih-Yung, Da Yeh Univ., Taiwan, Province of China; Chuang, Chih-Hsien, Da Yeh Univ., Taiwan, Province of China; Lin, Tzu-Yao, Da Yeh Univ., Taiwan, Province of China; Jan. 1998; In English
Contract(s)/Grant(s): NSC-85-2212-E212-005
Report No.(s): AIAA Paper 98-0431; Copyright; Avail: Aeroplus Dispatch

An experimental investigation of the 2D flow normal to a flat plate at low to medium Reynolds numbers (ranging from 25 to 393 based on the breadth of the plate) is described. Both horizontal and vertical soap film tunnels are used to set up a truly 2D experiment. The flow in the soap film is very thin and is a close approximation to 2D flow. Momentum defect measurements are used to obtain the time-averaged mean drag coefficient, Cd-bar, experienced by a normal flat plate via LDV. It is found that Cd-bar of about 2.1 for the current Re range. The present data agree well with available nominally 2D experimental results from previously published papers which were obtained in traditional towing tank, wind tunnel, and water tunnel experiments with high plate aspect ratios.
Author (AIAA)

Flat Plates; Aerodynamic Drag; Two Dimensional Flow; Drag Coefficients; Wind Tunnel Tests; Water Tunnel Tests

19980055732

Progress in measuring water impingement characteristics on aircraft surfaces

Papadakis, Michael, Wichita State Univ., USA; Vu, Giao T., Wichita State Univ., USA; Hung, Eric K., Wichita State Univ., USA; Bidwell, Colin S., NASA Lewis Research Center, USA; Bencic, Timothy, NASA Lewis Research Center, USA; Breer, Marlin D., Boeing Commercial Airplane Group, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG3-1775; NAG3-1985
Report No.(s): AIAA Paper 98-0488; Copyright; Avail: Aeroplus Dispatch

This paper provides a summary of experimental water droplet impingement research starting with the early efforts of NACA in the 1950s. Industry requirements for additional impingement data are discussed based on results from a recent industry survey. A new research program aimed at expanding and modernizing the existing water droplet impingement data is outlined. Improved experimental and data reduction methods for obtaining water impingement data are presented. A discussion of sources of error in the experimental and data reduction methods is provided. Relative humidity is shown to have a significant effect on the repeatability of the experimental data. Recent wind tunnel test results for an MS(1)-0317 airfoil and a three-element McDonnell Douglas high lift system are compared with computational results obtained with the LEWICE code. In most cases, the correlation between the analytical and experimental impingement efficiency distributions is good.
Author (AIAA)
Wind Tunnel Tests; Airfoils; Water; Liquid-Solid Interfaces; Impingement

19980055733

Beads and rivulets modeling in ice accretion on a wing

Louchez, P., Quebec, Univ., Canada; Fortin, G., Quebec, Univ., Canada; Mingione, G., CIRA - Centro Italiano Ricerche Aerospaziali, Italy; Brandi, V., CIRA - Centro Italiano Ricerche Aerospaziali, Italy; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0489; Copyright; Avail: Aeroplus Dispatch

This paper presents the preliminary results from the development of a new ice accretion thermophysical model, carried out through the joined efforts of the University of Quebec at Chicoutimi and CIRA. This model represents a first attempt to simulate the actual behavior of the water droplets that spread out on the wing surface. It reproduces, through an analytical approach, the different arrangements of the water on iced surfaces in order to overcome the well-known Messinger model limitations in the glaze ice accretion conditions. A wet regime is presented with an updated runback criterion and surface roughness calculations via modeling of the water beads, rivulets, and film that can form as a consequence of the presence of water remaining stationary on the surface.
Author (AIAA)
Aircraft Icing; Wings; Beads; Fluid Films; Water Flow

19980055758

A conservative algorithm for exchanging aerodynamic and elastodynamic data in aeroelastic systems

Farhat, Charbel, Colorado, Univ., Boulder, USA; Lesoinne, Michel, Colorado, Univ., Boulder; LeTallec, Patrick, Colorado, Univ., Boulder; INRIA, France; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0515; Copyright; Avail: Aeroplus Dispatch

The prediction of many fluid/structure interaction phenomena requires solving simultaneously the coupled fluid and structural equations of equilibrium with an appropriate set of interface boundary conditions. We consider the realistic situation where the fluid and structure subproblems have different resolution requirements and their computational domains have nonmatching discrete interfaces, and address the proper discretization of the governing interface boundary conditions. We present and overview new and common algorithms for converting the fluid pressure and stress fields at the fluid/structure interface into a structural load, and for transferring the structural motion to the fluid system. We discuss the merits of these algorithms in terms of conservation properties and solution accuracy, and distinguish between theoretically important and practically significant issues. We validate our claims and illustrate our conclusions with several transient aeroelastic simulations.
Author (AIAA)
Elastodynamics; Aeroelasticity; Fluid-Solid Interactions; Flutter; Aerodynamic Forces

19980055759

Higher-order staggered and subiteration free algorithms for coupled dynamic aeroelasticity problems

Farhat, Charbel, Colorado, Univ., Boulder, USA; Lesoinne, Michel, Colorado, Univ., Boulder; Jan. 1998; In English
Contract(s)/Grant(s): F49620-97-1-0059; NAG2-827
Report No.(s): AIAA Paper 98-0516; Copyright; Avail: Aeroplus Dispatch

We overview two sequential and parallel partitioned procedures that are popular in computational nonlinear aeroelasticity, and address their limitation in terms of accuracy and numerical stability. We propose two alternative serial and parallel staggered algorithms for the solution of coupled transient aeroelastic problems, and demonstrate their superior accuracy and computational efficiency with the flutter analysis of the AGARD Wing 445.6. We contrast our results with those computed by other investigators and validate them with experimental data.
Author (AIAA)
Aeroelasticity; Fluid-Solid Interactions; Parallel Processing (Computers); Flutter; Wing Oscillations

19980055764

Fully implicit aeroelasticity on overset grid systems

Melville, Reid B., USAF, Research Lab., USA; Morton, Scott A., USAF, Research Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0521; Copyright; Avail: Aeroplus Dispatch

An implicit time-accurate approach to aeroelastic simulation is developed using a Beam-Warming, approximate factored algorithm, coupled with a linear, second-order structural model. With subiteration, this approach becomes a fully implicit, second-order accurate aeroelastic solver. The flow domain is decomposed into an overset grid system for parallel implementation, and a grid deformation methodology is introduced to accommodate the deflection of aeroelastic surfaces. Several strategies for coupling the fluid and structural solvers are assessed for accuracy and efficiency.

Author (AIAA)

Aeroelasticity; Computational Grids; Computerized Simulation; Wind Tunnel Tests; Flight Tests

19980055883

Three-dimensional numerical simulation of wake vortex detection with the MFLAME 2 micron lidar

Darracq, Denis, CERFACS, France; Corjon, Alexandre, CERFACS, France; Ducros, Frederic, CERFACS, France; Keane, Mike, Univ. College, Ireland; Buckton, Daniel, Univ. College, Ireland; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0666; Copyright; Avail: Aeroplus Dispatch

This paper demonstrates that trailing wake vortices can be reliably detected from an axial point of view using Doppler lidar. Three-dimensional large eddy simulations of wake vortices are performed in order to investigate the performances of an airborne Doppler-lidar-based wake vortex detection system, known as the MFLAME system. Three test cases were investigated: Crow instabilities; wake vortex decay in isotropic homogeneous turbulence; and wake vortex collapse in the convective atmospheric boundary layer. In all cases, the axial velocity is not initialized. Once the appropriate flow field is computed, it is inputted into the MFLAME system simulator. The results indicate that a forward-looking Doppler lidar system is capable of detecting wake vortex signatures from several ages of the applied vortices.

Author (AIAA)

Aircraft Wakes; Vortex Breakdown; Three Dimensional Models; Optical Radar; Atmospheric Boundary Layer; Laser Doppler Velocimeters

19980055894

Using an array of transducers under a compliant wall to detect and control dynamic stall on a pitching airfoil

Sinha, S. K., Mississippi, Univ., University, USA; Pandey, M., Mississippi, Univ., University; Wang, H., Mississippi, Univ., University; Pal, D., Mississippi, Univ., University; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0678; Copyright; Avail: Aeroplus Dispatch

An array of electrostatic pressure transducers, employing a compliant wall as the sensing element, is used to investigate the initial formation stages of the dynamic stall vortex (DSV) on a rapidly pitching NACA-0012 airfoil at an Re(c) of 10 exp 6. The sensed signals were used to detect the influx of positive and negative vorticities as well as the shear-layer instability frequency characteristic of the DSV. Using the same transducers as electrostatic actuators, which can independently manipulate the influx of vorticities of opposing signs into the DSV, appears to be the best control strategy.

Author (AIAA)

Transducers; Pitching Moments; Airfoils; Aerodynamic Stalling; Electrostatics

19980055929

Aerodynamic primary breakup at the surface of nonturbulent round liquid jets in crossflow

Mazallon, J., Michigan, Univ., Ann Arbor, USA; Dai, Z., Michigan, Univ., Ann Arbor; Faeth, G. M., Michigan, Univ., Ann Arbor; Jan. 1998; In English

Contract(s)/Grant(s): F49620-92-J-0399; F49620-95-I-0364

Report No.(s): AIAA Paper 98-0716; Copyright; Avail: Aeroplus Dispatch

An experimental investigation of nonturbulent round liquid jets in air crossflows at normal temperature and pressure was carried out, using pulsed shadowgraphs to observe jet deformation and breakup. Test liquids included water, ethyl alcohol and glycerol mixtures. The observations suggest qualitative similarities between the surface breakup of nonturbulent round liquid jets in crossflow and the secondary breakup of drops; for example, for Ohnesorge numbers less than 0.1, the onset of breakup occurs as bag breakup beginning at a Weber number of 5, there is a second transition to a bag/shear breakup regime at a Weber number of 60 and a third transition to a shear breakup regime at a Weber number of 110. A long-ligament shear breakup regime appears at Ohnesorge numbers greater than 0.1. At the onset of breakup, the deformation of the liquid column yields a frontal diameter

roughly twice the initial jet diameter, relatively independent of the breakup regime. The characteristics of waves associated with the breakup process were also studied, finding that bag and bag/shear breakup involved both liquid column and surface waves while shear breakup involved only surface waves. The results also show that breakup characteristics are mainly influenced by the Weber number, while effects of the liquid/gas momentum ratio are small.
Author (AIAA)
Cross Flow; Jet Flow; Liquid Flow; Subsonic Flow; Aerodynamics

19980055972

Solution of two-equation models of turbulence using a universal adaptive finite element algorithm

Ignat, L., Ecole Polytechnique, Canada; Pelletier, D., Ecole Polytechnique, Canada; Ilinca, F., NRC of Canada, Industrial Materials Inst., Boucherville; Jan. 1998; In English
Contract(s)/Grant(s): F49620-96-1-0329
Report No.(s): AIAA Paper 98-0765; Copyright; Avail: Aeroplus Dispatch

This paper describes the application of a recently developed universal adaptive finite element algorithm to the simulation of several turbulent flows. The objective of the present work is to show how the controlled accuracy of adaptive methods provide the means to perform careful quantitative comparisons of two-equation models. The formulation uses the logarithmic form of turbulence variables, which leads naturally to a simple algorithm applicable to all two equation turbulence models. The new methodology is free of ad-hoc stability enhancement measures such as clipping and limiters which may often differ from one model to the other. Such techniques limit the predictive capability of a turbulence model and cloud the issues of a comparison study. The present procedure results in one adaptive solver applicable to all two-equation models. The approach is demonstrated by comparing three popular turbulence models on a few non-trivial flows. We have chosen the following models: the standard k-epsilon model, the k-tau model of Speziale and the k-omega model of Wilcox. The results demonstrate that accurate solutions can be obtained for all models, and that systematic comparison of turbulence models can be made.
Author (AIAA)
Airfoil Profiles; Turbulent Flow; Finite Element Method; K-Omega Turbulence Model; K-Epsilon Turbulence Model

19980055973

Numerical simulation of vortex shedding flows past moving obstacles using the k-epsilon turbulence model on unstructured dynamic meshes

Tran, Hai, Colorado, Univ., Boulder, USA; Koobus, Bruno, Colorado, Univ., Boulder; Farhat, Charbel, Colorado, Univ., Boulder; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0766; Copyright; Avail: Aeroplus Dispatch

We consider the numerical solution on unstructured dynamic meshes of the averaged Navier-Stokes equations equipped with the k-epsilon turbulence model and a wall function. We discuss discretization issues pertaining to moving grids and numerical dissipation, and present a robust spring analogy method for constructing dynamic meshes. We validate our implementation of this two-equation turbulence model and justify its usage for a class of vortex shedding problems by correlating our computational results with experimental data obtained for a flow past a square cylinder. We also apply our solution methodology to the two-dimensional aerodynamic stability analysis of the Tacoma Narrows Bridge, and report numerical results that are in good agreement with observed data.
Author (AIAA)
Vortex Shedding; K-Epsilon Turbulence Model; Computational Grids; Aerodynamic Stability; Aeroelasticity; Wall Flow

19980055978

On the use of CFD in the automotive engine cooling fan system design

Coggiola, Eric, Valeo Engine Cooling, France; Dessale, Bruno, Valeo Engine Cooling, France; Moreau, Stephane, Valeo Engine Cooling, France; Broberg, Robert, AEA, Ltd., Canada; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0772; Copyright; Avail: Aeroplus Dispatch

For the development of the fans used in the engine cooling systems, CFD now plays a key role as a design tool as well as an optimization tool. Until recently, both complex geometries and low-speed aerodynamics inherent to latter systems have prevented numerical simulations to be part of the design or reblading processes. Since the advent of general purpose CFD softwares capable of addressing the issues pertinent to the engine cooling system fans, Valeo has initiated a CFD based development of a new standard fan range. This paper presents the CFD strategy adopted and the results obtained on the new fans.
Author (AIAA)
Diesel Engines; Fan Blades; Cooling Systems; Computational Fluid Dynamics; Engine Design; Airfoil Profiles

19980055990

Direct harmonic linear Navier-Stokes methods for efficient simulation of wave packets

Streett, C. L., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0784; Copyright; Avail: Aeroplus Dispatch

Wave packets produced by localized disturbances play an important role in transition in 3D boundary layers, such as that on a swept wing. Starting with the receptivity process, we show the effects of wave-space energy distribution on the development of packets and other 3D disturbance patterns. Nonlinearity in the receptivity process is specifically addressed, including demonstration of an effect which can enhance receptivity of traveling cross-flow disturbances. An efficient spatial numerical simulation method is demonstrated for the computation of these flows, allowing most of the simulations presented to be carried out on a workstation.

Author (AIAA)

Navier-Stokes Equation; Wave Packets; Three Dimensional Boundary Layer; Swept Wings; Linear Equations; Boundary Layer Transition

19980056071

Local coefficients of heat transfer on optimised finned cylinders

Robertson, A. J., Oxford, Univ., UK; Neely, A. J., Oxford, Univ., UK; Ireland, P. T., Oxford, Univ., UK; Harper, L. R., Rolls-Royce, PLC, UK; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0875; Copyright; Avail: Aeroplus Dispatch

An experimental investigation of the convective performance of cylindrical fin extended surfaces, with application to the cooling of aviation gas turbine components, is reported. In particular, two novel fin geometries, designed to reduce the amount of metal above a certain critical temperature, without increasing the finning mass, are discussed. These approaches are particularly well suited to mass critical aerospace applications. The first optimized geometry was designed after finite element studies of data from transient heat transfer experiments on concentric circular finned cylinders had indicated the presence of significant hot spots. Fin mass is transferred from cool to hot regions in order to eliminate temperature peaks. The second geometry investigates fin interruptions as a method of thermal boundary layer enhancement. Both geometries were experimentally investigated and their resultant performance analyzed in a finite element simulation. This technique enables the full surface mapping of local heat transfer coefficients on the surface of the fins.

Author (AIAA)

Heat Transfer; Fins; Cylinders; Cooling Systems; Aerospace Engineering

19980056416

A novel broadband all-wireless access network using stratospheric platforms

Hase, Yoshihiro, Communications Research Lab., Japan; Miura, Ryu, Communications Research Lab., Japan; Ohmori, Shingo, Communications Research Lab., Japan; Feb. 1998; In English

Report No.(s): AIAA Paper 98-1397; Copyright; Avail: Aeroplus Dispatch

This paper proposes a novel broadband access network using a number of stratospheric platforms. This is a new wireless infrastructure, and consists of a wireless access link between the platform and terminals in Ka-band and a mesh-like network using optical interplatform links. One platform covers a 40 km x 40 km area with 64 beams of an onboard multibeam antenna. Thus, the cell size is almost the same as that of current cellular systems. This network can provide 25 Mbps to more than 156 Mbps access links and flexible wireless ATM network to subscribers.

Author (AIAA)

Broadband; Wireless Communication; Asynchronous Transfer Mode; Optical Communication; Flying Platforms; Stratosphere

19980056486

Skin friction measurements on a rotor in hover

Wadcock, Alan J., Sterling Software, USA; Yamauchi, Gloria K., NASA Ames Research Center, USA; Driver, David M., NASA Ames Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The oil-film interferometric skin friction technique is described and applied to an isolated full-scale rotor in hover. This is the first time that this technique has been applied to a rotary wing. The chordwise component of skin friction is presented for both low and high thrust cases. The technique is shown to be capable of revealing the presence of natural transition, leading edge laminar separation followed by turbulent reattachment, and the presence of reversed flow.

Author (AIAA)

Rotary Wings; Skin Friction; Friction Measurement; Interferometry; Fluid Films

19980056578

Manufacturing-performance-cost relationships in gamma TiAl castings

McQuay, Paul, Howmet Research Corp., USA; Larsen, Don, Howmet Research Corp., USA; 1997, pp. 523-529; In English
Contract(s)/Grant(s): F33615-92-C-5900; Copyright; Avail: Aeroplus Dispatch

This paper focuses on three major initiatives aimed at reducing the cost and improving the quality of gamma TiAl castings: gravity metal mold (GMM); low-cost alloy meltstock; and a simplified HIP and heat treatment. The manufacturing-cost-performance relationships of the baseline process vs the proposed process are discussed. These three initiatives together can provide a significant cost reduction in cast gamma TiAl components, while concomitantly providing an equivalent or improved balance of properties.
Author (AIAA)

Titanium Aluminides; Cost Reduction; Face Centered Cubic Lattices; Investment Casting; Product Development; Aircraft Engines

19980056590

Impact resistance of NiAl alloys

Walston, W. S., GE Aircraft Engines, USA; Darolia, R., GE Aircraft Engines, USA; 1997, pp. 613-619; In English; Copyright; Avail: Aeroplus Dispatch

Ballistic impact tests were conducted on NiAl alloys using conditions similar to those in the turbine section of aircraft engines. Several parameters including velocity, impacting particle mass and thickness, target thickness and impact angle were varied in tests conducted at approximately 980 C. Impact damage of the single crystal NiAl alloy typically occurred due to high bending stresses on the backside of the impact panel, resulting in complete failure of the specimen. Impact angle and target thickness were found to be important in determining the impact resistance of the specimens. It was found that single crystal NiAl alloys do not survive most impact conditions simulative of turbine blades, but demonstrated feasibility under impact conditions simulative of turbine vanes. The single crystal NiAl alloy results were similar to silicon nitride results reported in the literature, while a NiAl eutectic alloy evaluated in this study performed slightly better than both of these materials.
Author (AIAA)

Nickel Aluminides; Intermetallics; Impact Strength; Aircraft Engines; Impact Tests; Bending Moments

19980056660

Controlling interfaces for structural assembly

Aerospace Engineering; Feb. 1998; ISSN 0736-2536; Volume 18, n, nos. 1-2, pp. 33-35; In English; Copyright; Avail: Aeroplus Dispatch

Aircraft design-for-manufacture-and-assembly practices relevant to large assemblies are discussed. The least expensive way of making or assembling large structures is by producing one side of each interface within reasonable tolerances, while designing the other side of the interface to 'drape and fit' without allowing interference from tooling.
AIAA

Aircraft Design; Aircraft Structures; Tooling; Solid-Solid Interfaces; Aircraft Production; Process Control (Industry)

19980056812

Predictions of widespread fatigue damage thresholds in aging aircraft

Wang, L., California, Univ., Los Angeles, USA; Chow, W. T., Georgia Inst. of Technology, Atlanta; Kawai, H., Georgia Inst. of Technology, Atlanta; Atluri, S. N., Georgia Inst. of Technology, Atlanta; AIAA Journal; Jan. 1998; ISSN 0001-1452; Volume 36, no. 3, pp. 457-464; In English; Copyright; Avail: Aeroplus Dispatch

Commercial transport aircraft are required to operate under the concept of damage tolerance. Because of the structural redundancy and the crack arrest capability, the current fleet of commercial aircraft was initially designed to have sufficient residual strength to sustain discrete source damage. However, fatigue damage during the life of an aircraft can significantly reduce the residual strength of an aging aircraft. It is important to predict the threshold for the onset of widespread fatigue damage, i.e., the initiation and growth of cracks at rivet holes (multiple site damage) to threshold sizes at which, in conjunction with a lead crack, the residual strength of the aircraft may fall below the limit load. A hierarchical global-intermediate-local approach is presented for the numerical predictions of the widespread fatigue damage thresholds. A detailed numerical study is presented to illustrate the importance of (1) the use of elastic-plastic fracture mechanics to assess the residual strength and (2) the importance of the local

stresses due to rivet misfit, clamping, cold working, fretting, etc., in assessing the number of fatigue cycles to reach the widespread fatigue damage threshold for an aging aircraft.
Author (AIAA)
Transport Aircraft; Critical Loading; Residual Strength

19980056974

Battlespace 2000 emerging intelligence/surveillance communication architectures in support of the forward deployed warrior in the 21st century

Wright, Marshall N., L-3 Communication Systems-West, USA; 1997, pp. 82-92; In English; Copyright; Avail: Aeroplus Dispatch

In recent years many of the airborne sensor technology development goals of the reconnaissance and surveillance communities have been either realized or about to come ’on stream’. The challenge now is to get that sensor information to the warfighter in a comprehensive and timely manner. In this paper we will look at the communications architectures that will bring this information to the Navy’s Battle Group Commander and enable him to fully coordinate sensor-to-shooter, theater-based mission planning. The Common High Bandwidth Data Link - Surface Terminal (CHBDL-ST) will be central to that architecture. CHBDL-STs installed on carriers and amphibians receive data over the Common Data Link (CDL) from the airborne sensors providing digital imagery, signal intelligence, IR, and radar. This paper explores how CHBDL-ST, as the cornerstone of the Carrier Battle Group’s reconnaissance/surveillance communications architecture, will (1) receive data from the UAV’s; (2) improve the time to receive and process imagery; (3) impact the dissemination of intelligence data - fleet wide; (4) provide a battle picture for the forward deployed warrior; and (5) provide support for the forward deployed warrior.
Author (AIAA)
Military Operations; Data Links; Infrared Radar; Communication Networks; Pilotless Aircraft

19980057166

Optimum design of composite wing model for aeroelastic properties

Kameyama, Masaki, Tohoku Univ., Japan; Fukunaga, Hisao, Tohoku Univ., Japan; Sekine, Hideki, Tohoku Univ., Japan; 1997, pp. 1125-1130; In English; Copyright; Avail: Aeroplus Dispatch

The present paper treats the static aeroelastic characteristics of cantilevered composite plates. The static aeroelastic characteristics are analyzed by using the FEM based on the classical lamination theory. Optimum design of forward-swept composite wings with respect to static aeroelastic characteristics is investigated. The optimal laminate configurations are obtained by using a mathematical programming method in which lamination parameters are used as design variables. The effectiveness of aeroelastic tailoring, which improves the aeroelastic characteristics of the composite wing by the layup optimization, is examined through the optimal results for wings with various sweep angles.
Author (AIAA)
Wing Profiles; Structural Design; Aeroelasticity; Cantilever Plates; Composite Materials; Lay-Up

19980057181

Application of carbon-carbon composites to dovetail joint structures

Kogo, Yasuo, Tokyo, Science Univ., Japan; Hatta, Hiroshi, Inst. of Space and Astronautical Science, Japan; Toyoda, Masaji, Takushoku Univ., Japan; Sugibayashi, Toshio, Takushoku Univ., Japan; 1997, pp. 1545-1550; In English; Copyright; Avail: Aeroplus Dispatch

In a development study of the air-turbo-ramjet (ATR) engine for a space plane, application of carbon-carbon (C/C) composites play an important role in achieving expected performance of the engine. Above all, dovetail joint structures are one of the key structures for implementing the turbine structure using C/C composites. From this point of view, a feasibility study was carried out analytically and experimentally. Tensile tests were carried out on a simplified dovetail joint model made of 2D and 3D reinforced C/C composites. A shoulder angle of the dovetail was taken as a parameter to optimize the shape of the dovetail. Finite element analysis was also carried out for various shoulder angles. Results suggest that fracture of the dovetail joint is controlled by the average shear stress, which implies that shear stress concentration on the shoulder is relaxed during failure process of the C/C composites. It is also shown that the dovetail joint made of C/C composites is feasible for the ATR engine.
Author (AIAA)
Carbon-Carbon Composites; Ramjet Engines; Turbojet Engines

19980057225

Development status of resin transfer and resin film infusion moulding for structural applications

Mills, A. R., Cranfield Univ., UK; Hogg, P. J., Queen Mary and Westfield College, UK; 1997, pp. 1085-1090; In English; Copyright; Avail: Aeroplus Dispatch

The benefits of resin transfer and resin film infusion molding which explain the large scale of process development over the past decade are described with reference to commercial applications. Problems for the technology which limit its cost-effective application are discussed, and innovations to overcome them described. The technology factors which need still need to be addressed for further, more cost-effective applications are considered.

Author (AIAA)

Resin Transfer Molding; Commercial Aircraft

19980057278

Development of MMC rotor for advanced material gas-generator

Moriya, Katsuyoshi, Research Inst. of Advanced Material Gas-Generator, Japan; Suzumura, Nobuyuki, Research Inst. of Advanced Material Gas-Generator, Japan; Nishide, Shigeto, Research Inst. of Advanced Material Gas-Generator, Japan; Onozuka, Masakazu, Research Inst. of Advanced Material Gas-Generator, Japan; Masaki, Shoji, Research Inst. of Advanced Material Gas-Generator, Japan; Yasuhira, Kohichi, Research Inst. of Advanced Material Gas-Generator, Japan; 1997, pp. 411-416; In English; Copyright; Avail: Aeroplus Dispatch

Matrix coated fiber process was used to fabricate MMC rings. The matrix material was Ti-6Al-4V, which was deposited onto SiC fiber with electron beam physical vapor deposition. MMC rings were consolidated with hot press and HIP. Coupon tensile test results showed modulus near a theoretical prediction, but tensile strength was below prediction. Burst spin test results coincided with the coupon test results. The advantages and potential of the matrix-coated fiber process for MMC ring fabrication are discussed.

Author (AIAA)

Rotors; Gas Generators; Metal Matrix Composites; Titanium Alloys; Silicon Carbides

19980057289

Swaging workability of DURALCAN tube and its mechanical properties after swaging and welding

Hori, Hisashi, Nippon Light Metal Co., Ltd., Japan; Hino, Harumichi, Nippon Light Metal Co., Ltd., Japan; 1997, pp. 497-502; In English; Copyright; Avail: Aeroplus Dispatch

The swaging workability of a Duralcan tube is examined, and its mechanical properties and accuracy are investigated. In the conventional swaging method, the swaging workability of Duralcan tube was comparable or a little inferior to that of aluminum alloy tube. We have developed a new swaging process to suppress the occurrence of the warp at the end of the swaged tube. The end of the worked tube was straight, and the accuracy of the tube using the new process satisfied the requirements. The shear strength of welds between the newly processed tube and the yoke increased by 30 percent compared with that swaged conventionally.

Author (AIAA)

Mechanical Properties; Welding; Swaging; Tubes; Metal Matrix Composites; Propellers

19980057295

Process induced void formation in a high performance structural composite system manufactured by autoclave lay-up processing

Shim, Sang-Beom, MIT, USA; Seferis, James C., Washington, Univ., Seattle; Hudson, William, Heath Tecna Aerospace Co., USA; Journal of Advanced Materials; Jul. 1997; ISSN 1070-9789; Volume 28, no. 4, pp. 26-36; In English; Copyright; Avail: Aeroplus Dispatch

Void formation in a high performance composite structure was addressed in this study. Voids are known to be detrimental to the mechanical performance of aircraft structural composites. A toughened prepreg system commercially available for aircraft structural application was utilized. This research focused on understanding void generation in composite structure caused by different lay-up procedures. The amount of voids was characterized via ultrasonic C-scan analysis, density measurements, and optical microscopy, with the objective of integrating the results of the three different void content characterization methods. Void distribution results obtained by ultrasonic C-scan analysis were consistent with those of density measurements. The void content distribution caused by a metal plate was observed after the composite fabrication, and this behavior was modeled into a caul plate number (CPN) definition. Through a vast array of composite fabrication and void content investigation, appropriate lay-up techniques were found to be indispensable in reducing the void content in the composite structure. Collectively, voids are detrimental

to composite performance, and voids should be reduced or eliminated by the use of appropriate autoclave processes. Void formation in the composite structure during autoclave processing was attributed to not only inherent material properties but also processing conditions and their proper specifications.
Author (AIAA)
Composite Structures; Voids; Aircraft Structures; Mechanical Properties; Lay-Up

19980057497

Laser shock processing of materials - Characterization and application of the process

Peyre, Patrice, CNRS, Lab. d'Application des Lasers de Puissance, France; Berthe, Laurent, CNRS, Lab. d'Application des Lasers de Puissance, France; Fabbro, Remy, CNRS, Lab. d'Application des Lasers de Puissance, France; Scherpereel, X., CNRS, Lab. d'Application des Lasers de Puissance, France; Bartincki, E., CNRS, Lab. d'Application des Lasers de Puissance, France; 1997, pp. 558-569; In English; Copyright; Avail: Aeroplus Dispatch

The main objective of this work was first to set up the basic principles of laser shock processing (LSP), then to characterize and control the laser-induced surface stress loadings and lastly, through different material applications, to evaluate its potential as a competitive surface treatment. In a first part, general aspects of LSP are presented, from the physical shock wave generation mode in water-confined regime to the mechanical modifications conventionally induced in metals (plastic strain and compressive stresses). In a second part, we focus on an experimental characterization of the process to highlight the influence of several process aspects on the stress wave generation; such different parameters as coating effects, laser spot size effects or plastic flow limit determination at very high strain rate were studied for most materials investigated. General trends are drawn concerning the mechanical changes of surfaces with LSP as a function of shock parameters.
Author (AIAA)
Laser Applications; Residual Stress; Surface Treatment; Metal Fatigue; Aeronautics; Velocity Measurement

19980058302

Analysis of effect of crack on the natural frequency of blade

Xu, Kejun, Navy Aviation Technique Academy, China; Jiang, Longping, Navy Aviation Technique Academy, China; Journal of Propulsion Technology; Dec. 1997; ISSN 1001-4055; Volume 18, no. 6, pp. 68-71; In Chinese; Copyright; Avail: Aeroplus Dispatch

A method for analyzing the effect of two traverse cracks on the natural frequency of the flexural vibrations in a blade is presented. Two types of crack are considered: a double-sided crack occurring in the case of cyclic loadings, and single-sided crack, which in principle occurs as a result of impulse loading. It is assumed that the blade is a nontorsional beam with a rectangular cross-section, and the cracks extend through the width of the beam with constant depth.
Author (AIAA)
Resonant Frequencies; Bending Vibration; Turbine Blades; Aircraft Engines; Dynamic Structural Analysis

19980058396

Aerospace design - A complex task

Giles, M. B., Oxford, Univ., UK; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Some of the complexities inherent in the design of aeroengines and aircraft are identified. It is argued that to handle the geometric complexities requires a computational representation which is hierarchical and based on parametric solids at the lowest level. On top of this can be built a tightly coupled two-level design system which uses an integrated set of multidisciplinary analysis packages which are also hierarchical, with differing levels of approximation and computational cost appropriate to preliminary design and detailed component design. A range of different numerical approaches to design are outlined, and their strengths and weaknesses are compared. Other related topics, such as distributed computing, risk management, and strategic research planning, are also discussed.
Author (AIAA)
Optimization; Aircraft Design; Engine Design; Aircraft Engines; Aeronautical Engineering

19980058397

ICIASF '97 - International Congress on Instrumentation in Aerospace Simulation Facilities, 17th, Pacific Grove, CA, Sept. 29-Oct. 2, 1997, Record

1997; In English; ISBN 0-7803-4167-8; Copyright; Avail: Aeroplus Dispatch

Various papers on aerospace simulation facilities are presented. Individual topics addressed include: correcting luminescent paint measurements for self-illumination, pressure-sensitive paint (PSP) limitations and solutions, techniques for using PSP in

shock tunnel facilities, global luminescent lifetime measurements on a body in free fall, DLR PSP system intensity and lifetime measurements, development of a liquid oxygen density reference system, design and a calibration of an unsteady pressure measurement system, special six-component jet rig balance for studying new thrust vectoring concepts, back step flow measurements using triple split film probe, new concepts for four-hole wall stress probes, measurement methods and properties of anisotropic flows excited by bulk force, and orbital platform rotary balance system for the IAR water tunnel. Also considered are: digital PIV system for real-time wind tunnel measurements, comparisons between current high-speed film and video recording, PIV using Bragg cell as optical shutter, gas-surface interaction measured by spectroscopy methods, Rayleigh light scattering as a pulse local probing of non-equilibrium gas flows, fiber optic pressure/skin friction gage for supersonic flow applications, developing a stress wave thrust balance for a hypersonic shock tunnel, Fabry-Perot photonic temperature sensor system, real gas flow characterization in the ONERA F4 high enthalpy wind tunnel, temperature tomographic sensor for combustion analysis, and current state and potentialities of hypersonic MHD-gas acceleration wind tunnels.
AIAA
Conferences; Simulators; Wind Tunnels; Wind Tunnel Apparatus

19980058407

Visualization of the quiet test region in a supersonic wind tunnel using luminescent paint

Asai, Keisuke, National Aerospace Lab., Japan; Kunimasu, Tetsuya, National Aerospace Lab., Japan; Iijima, Yoshimi, National Aerospace Lab., Japan; 1997, pp. 84-94; In English; Copyright; Avail: Aeroplus Dispatch

A temperature-sensitive luminescent paint technique has been used to visualize boundary-layer transition on a 10 deg cone model in the 0.2-m Supersonic Wind Tunnel at National Aerospace Laboratory. A luminescent paint based on EuTTA was applied on the model surface using airbrush. The paint coating was excited by a Xenon light and the luminescence image was acquired using a high resolution cooled-CCD camera. to enhance thermal signature across transition, tunnel flow was heated by a sudden shutdown of cooling water supply to heat exchanger. Two images were taken for each condition, one is transient image taken in heating process and the other is reference image taken in steady condition. by ratioing these two images, global transition patterns on the cone have been visualized as the edges of brightness. From transition images at various model locations in the test section, it was found that transition remains at a fixed spatial location with respect to the tunnel. This indicates that the cone transition is induced by radiated noise propagating from turbulent boundary layers on the tunnel walls. Effects of the stagnation pressure were also studied over the range from 55 to 150 kPa. The extent of quiet test region was found to be strongly sensitive to the pressure or unit Reynolds number. At the NAL 0.2-m SWT, natural transition did not occur on the cone at lower values of unit Reynolds number.
Author (AIAA)
Luminescence; Supersonic Wind Tunnels; Flow Visualization; Boundary Layer Transition

19980058408

Blade deformation and PSP measurements on the large scale rotor by video metric system

Bosnyakov, S., TsAGI, Russia; Bykov, A., TsAGI, Russia; Coulech, V., TsAGI, Russia; Fonov, Sergey, TsAGI, Russia; Morozov, A., TsAGI, Russia; Moskalik, V., TsAGI, Russia; Moskalik, L., TsAGI, Russia; Mosharov, V., TsAGI, Russia; Orlov, A., TsAGI, Russia; Radchenko, V., TsAGI, Russia; 1997, pp. 95-104; In English
Contract(s)/Grant(s): N68171-95-C-9131; Copyright; Avail: Aeroplus Dispatch

A helicopter blade during rotation accomplishes a complex spatial movement and deformation. The first part of the report is devoted to a Blade Deformation Measuring System (BDMS), which was developed to measure parameters of blade movement and its bending-twisting deformation. This part describes the measurement system and the basic measurement principles. Results of laboratory investigations are discussed as well. A pre-prototype of the BDMS was investigated in the TsAGI T-101 wind tunnel. BDMS provides twisting deformation measurement with mean squared deviation (MSD) of about 3-6 angular minutes and linear displacement measurements with MSD about 0.3-0.6 mm for a real scale helicopter rotor. The second part describes results of the evaluation tests with pressure-sensitive paint which were conducted by a pressure measurement extension of the BDMS. The first results obtained during the wind tunnel tests are presented and compared with pressure port data.
Author (AIAA)
Rotary Wings; Deformation; Twisting; Wind Tunnel Apparatus; Video Equipment

19980058436

Fabry-Perot photonic temperature sensor system

Tuma, Margaret L., NASA Lewis Research Center, USA; Elam, Kristie A., Gilcrest Electric, USA; Sawatari, Takeo, Sentec Corp.,

USA; Gaubis, Phil, Sentec Corp., USA; Lin, Yuping, Sentec Corp., USA; 1997, pp. 369-377; In English; Copyright; Avail: Aeroplus Dispatch

In this work a photonic sensor was utilized to monitor the exhaust gas temperature (EGT) of an OV-10D aircraft engine. The sensor has successfully flown over 50 hours and is proven to be immune to source fluctuations, surface deterioration of the optical element (located inside the sensor head), and able to withstand and operate in normal flight conditions as well as sustained severe flight conditions with forces exceeding 4 g's. Potential commercial uses for this sensor include monitoring temperature for aeropropulsion system control, military vehicle and naval engine control, conventional and nuclear power plant monitoring, and industrial plant monitoring.

Author (AIAA)

Temperature Sensors; Aircraft Engines; Gas Temperature; Temperature Measurement; Photonics

19980058570

Sky Station Stratospheric Telecommunications System, a high speed low latency switched wireless network

Lee, Yee-Chun, Sky Station International, USA; Ye, Huanchun, Sky Station International, USA; 1998, pp. 25-32; In English

Report No.(s): AIAA Paper 98-1394; Copyright; Avail: Aeroplus Dispatch

Sky Station is a novel telecommunications network which employs a proprietary stratospheric platform technology to provide broadband wireless communications services around the world. The stratospheric platform is a super-pressurized helium-filled solar/fuel-cell powered airship with enough payload and power capacity to support all of a metropolitan area's broadband communications requirements. The Sky Station airship uses propulsion and thermal control to keep it stationary for no less than five years at 21 km altitude. Through the stratospheric infrastructure, the Sky Station stratospheric telecommunications system (STS) will offer fixed or transportable full duplex E-1 uplink and 10 Mbps downlink services to the desktop or laptop. This is sufficient to support such multimedia services as video-telephony, low-cost video-conferencing, and high-speed Internet connectivity. The built-in security measure provides wire-line equivalent privacy (WEP) to insure high degree of privacy of communications. The Sky Station STS employs an end-to-end ATM architecture using UNI 4.0 and PNNI signaling protocols and can support AAL5 ABR/VBR and CBR services. The first-generation SSI STS will have a capacity of 7 Gbps between the user terminals and the STS platform and another 4.1 Gbps of highspeed trunk links between the platform and the ground stations for PSTN and Internet connectivity.

Author (AIAA)

Stratosphere; Telecommunication; Wireless Communication; Airships

19980058652

Carrier slip compensating time diversity scheme for helicopter satellite communication systems

Uchiki, Tatsuya, Mitsubishi Electric Corp., Japan; Kojima, Toshiharu, Mitsubishi Electric Corp., Japan; Miyake, Makoto, Mitsubishi Electric Corp., Japan; Fujino, Tadashi, Mitsubishi Electric Corp., Japan; 1998, pp. 635-641; In English

Report No.(s): AIAA Paper 98-1343; Copyright; Avail: Aeroplus Dispatch

This paper proposes a novel signal transmission scheme for helicopter-satellite communications. The proposed scheme is based on time diversity and combined with a novel algorithm to suppress the influence of carrier phase slip. In the proposed scheme, carrier phase slip is detected in cross-correlation processing of the received signal and is effectively suppressed. The proposed scheme thus makes it possible to employ CPSK modulation to achieve BER performance superior to that of DPSK modulation even in the low carrier-to-noise power ratio environment.

Author (AIAA)

Satellite Communication; Helicopters; Space Communication; Computerized Simulation; Bit Error Rate

19980059494

Optimum finned tubular space radiator

Ramesh, N., Indian Inst. of Technology, India; Venkateshan, S. P.; Heat Transfer Engineering; Oct-Dec, 1997; ISSN 0145-7632; Volume 18, no. 4, pp. 69-87; In English; Copyright; Avail: Issuing Activity

A two-dimensional finite-difference method of analysis is employed to elicit information pertaining to the thermal performance characteristics of a tubular space radiator with attached fins. The potential importance of the base surface interaction is brought out. The analysis takes into account the variation of base temperature, which has not been considered so far. A wide range of thermal and geometric parameters that are normally employed in the design of a tubular radiator has been considered. The exis-

tence of an optimum fin height and its dependence on other parameters have been explored. A new dimensionless heat dissipation parameter has been defined, and correlations that would aid the designer are presented.
Author (EI)
Finned Bodies; Heat Transfer; Finite Difference Theory; Temperature; Fins

19980060108

Development of ceramic components for gas turbine applications

Gubbels, G. H. M., TNO-Centre for Technical Ceramics, Netherlands; van der Heijde, J. C. T., TNO-Centre for Technical Ceramics, Netherlands; Brinkman, H. W., TNO-Centre for Technical Ceramics, Netherlands; Linden, J. L., TNO-Centre for Technical Ceramics, Netherlands; Terpstra, R. A., TNO-Centre for Technical Ceramics, Netherlands; Key Engineering Materials; 1997; ISSN 1013-9826; Volume 13, pt. 3, pp. 2096-2099; In English; Copyright; Avail: Aeroplus Dispatch

The use of advanced ceramics for the critical components in the hottest sections of the turbines offers the most promising solution for increasing the turbine efficiency. The objective of phase 1 of this project, sponsored by the Dutch Organisation for Energy and the Environment (NOVEM) is the development of materials for application in a small gas turbine. In this paper the work of a part of phase 1 is summarized. The preparation and characterization of in-situ reinforced silicon nitride, fiber-reinforced silicon carbide, and several joining technologies for the connection of ceramics to metal are discussed.
Author (AIAA)
Ceramics; Gas Turbine Engines; Engine Parts; Product Development; Ceramic Matrix Composites; Ceramic Fibers

19980060268

A photoelastic study of crack repair

Hastie, R. L., U.S. Air Force Academy, USA; Fredell, R., U.S. Air Force Academy, USA; Dally, J. W., Maryland, Univ., College Park; Experimental Mechanics; Mar. 1998; ISSN 0014-4851; Volume 38, no. 1, pp. 29-36; In English; Copyright; Avail: Aeroplus Dispatch

Birefringent coatings have been employed to study the effectiveness of an adhesively bonded repair of a center-cracked tension panel. The repair was one sided, with photoelastic coatings applied to the opposite side. Photoelastic coatings were also applied over the patch. Analysis methods are presented to permit the stress intensity factor to be determined from the isochromatic fringe patterns recorded from both continuous and X- and Y-edged coatings. The results showed that the one-sided adhesively bonded patch reduced the stress intensity factor; however, the repair did not markedly change the character of stress distributions. Fringe loops formed near the crack tips for both the cracked and repaired tension panels. The primary difference was in the size of the loops. The reduction in K(I) due to repair was smaller than anticipated, but even small improvements in Delta K(I) markedly enhance the life of a repaired panel. The Paris power law is used to show the relation between the reduction in Delta K(I) and the improvement in the crack growth rate da/dN. Fringe patterns from the birefringent coatings applied to the patch provided a means not only to investigate the stresses in the patch but also to detect the initiation of the local debonding of the adhesive in the neighborhood of the crack. The birefringent coating on the patch is an approach for producing an optically 'smart' repair.
Author (AIAA)
Crack Closure; Photoelastic Analysis; Adhesive Bonding; Tensile Stress; Stress Intensity Factors; Fuselages

19980060289

Applying the similarity method to the calculation of heat flows and friction stress in the vicinity of the plane of symmetry of blunt bodies using full Navier-Stokes equations ***Primenenie metoda podobiya dlya rascheta teplovykh potokov i napryazheniya treniya v okrestnosti ploskosti simmetrii zatuplennykh tel v ramkakh polnykh uravnenij Nav'e-Stoksa***

Brykina, I. G., Russia; Sakharov, V. I.; Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza; Aug. 1997; ISSN 0568-5281, no. 4, pp. 9-16; In Russian; Copyright; Avail: Aeroplus Dispatch

The paper is concerned with three-dimensional supersonic and hypersonic flows of a viscous gas past blunt bodies at angle of attack in the vicinity of the plane of symmetry. A method is developed which combines a numerical algorithm for solving two-dimensional Navier-Stokes equations and the analogy method which makes it possible to obtain solutions for three-dimensional problems from calculations of two-dimensional flows around equivalent two-dimensional bodies. The accuracy of the method is estimated by comparing the calculation results with more accurate results obtained from the numerical solution of three-dimensional equations.
AIAA
Supersonic Flow; Blunt Bodies; Heat Transmission; Shear Stress; Angle of Attack; Hypersonic Flow

19980060320

Guidelines for physics-of-failure based accelerated stress testing

Upadhyayula, Kumar, Maryland, Univ., College Park, USA; Dasgupta, Abhijit, Maryland, Univ., College Park; 1998, pp. 345-357; In English; Copyright; Avail: Aeroplus Dispatch

A systematic accelerated stress testing approach, based on physics-of-failure (PoF) principles, is presented for reliability assessment of an avionics electronic module. Results from this case study demonstrate that combined accelerated stress tests may produce complex synergies that can only be controlled through precise PoF assessment. The paper concludes with a set of generic guidelines to design, plan, conduct, and successfully implement Pof-based accelerated stress tests.

Author (AIAA)

Avionics; Electronic Modules; Failure Analysis; Accelerated Life Tests; Stress Analysis

19980060367

The need for measurement based reliability evaluation

Hecht, Myron, SoHaR, Inc., USA; 1998, pp. 216, 217; In English; Copyright; Avail: Aeroplus Dispatch

Defensible quantitative assessments of the reliability and availability of computer systems including software is possible. This position paper characterizes the need for quantitative empirically based dependability assessment, describes some of the previous work in this area, and identifies problems. While there is still ongoing research in measurement-based analysis of computer system dependability, the techniques developed in the area have achieved significant experimental results. Measurement-based analysis can also provide verification of assumptions and parameters used in the design models. The results are useful for designing and maintaining highly dependable computer systems intended for use in critical applications such as flight control, ground transportation, ATC, and nuclear power plant safety systems.

Author (AIAA)

Software Reliability; Reliability Analysis; Computer Systems Performance; Flight Control; Safety Factors

19980060563

Natural convection in inclined rectangular enclosures with perfectly conducting fins attached on the heated wall

Lakhal, E. K., Faculty of Sciences Semlalia, Morocco; Hasnaoui, M.; Bilgen, E.; Vasseur, P.; Heat and Mass Transfer/Waerme- und Stoffuebertragung; June, 1997; ISSN 0042-9929; Volume 32, no. 5, pp. 365-373; In English; Copyright; Avail: Issuing Activity

The natural convection heat transfer in inclined rectangular enclosures with perfectly conducting fins attached to the heated wall is numerically studied. The parameters governing this problem are the Rayleigh number (10(sup 2) less than or = Ra less EQ 2 x 10(sup 5)), the aspect ratio of the enclosures (2.5 less than or = A = H'/L' less than or = infinity), the dimensionless lengths of the partitions (0 less than or = B = l'/L' less than or = 1), the aspect ratio of micro-cavities (A0.33), the inclination angle (0 less than or = phi less than or = 60 deg) and the Prandtl number (Pr = 0.72). The results indicate that the heat transfer through the cover is considerably affected by the presence of the fins. At low Rayleigh num, the heat transfer regime is dominated by conduction. When B approximately = 0.75 and C approximately = 0.33, the heat transfer through the cold wall decreases considerably. This trend is enhanced when the enclosure is inclined. Useful engineering coions are derived for practical applications.

Author (EI)

Free Convection; Rayleigh Number; Heat Transfer; Enclosures; Aspect Ratio; Fins

19980060564

Combined effects of inlet fluid flow and temperature nonuniformity in cross flow plate-fin compact heat exchanger using finite element method

Ranganayakulu, Ch., Aeronautical Development Agency, India; Seetharamu, K. N.; Heat and Mass Transfer/Waerme- und Stoffuebertragung; June, 1997; ISSN 0042-9929; Volume 32, no. 5, pp. 375-383; In English; Copyright; Avail: Issuing Activity

An analysis of a crossflow plate-fin heat exchanger accouning for the combined effects of inlet fluid flow nonuniformity and temperature nonuniformity on both hot and cold fluid sides is carried out using a Finite Element Model. A mathematical equation is developed to generate different types of fluid flow/temperature maldistribution models considering the possible deviations in inlet fluid flow. Using these fluid flow maldistribution models, the exchanger effectiveness and its deteriorations due to flow/temperature nonuniformity are calculated for entire range of design and operating conditions. It was found that the performance deteriorations are quite significant in some typical applications due to inlet fluid flow/temperature nonuniformity.

Author (EI)

Cross Flow; Finite Element Method; Fluid Flow; Heat Exchangers; Inlet Flow; Fins; Heat Transfer; Temperature Distribution

19980060583

Flow visualization in an internal mixer using new experimental rotors including different rotor speed ratios ***Fliessvorgang im Innenmischer durch Einsatz neuer experimenteller Schaufeln und Vergleich verschiedener Rotor-Geschwindigkeitsverhaltnisse***

Cho, J. W.; White, J. L.; Pomini, L.; KGK-Kautschuk und Gummi Kunststoffe; Oct, 1997; ISSN 0948-3276; Volume 50, no. 10, pp. 728; In German; Copyright; Avail: Issuing Activity

In this paper we describe flow visualization studies of two new experimental rotor designs for internal mixers. The capabilities of these rotors to traditional two wing and four wing rotors are compared. The experiments described involve a) flow visualization of homogenizing bales of initially different colors, b) measured torques, c) determining dump temperatures, and d) flow visualization of carbon black incorporation into rubber.

Author (EI)

Flow Visualization; Rotor Speed; Rubber; Rotors

19980060625

Hydrodynamics and mass transfer studies in a novel external-loop airlift reactor

Guo, Y. X., Natl. Univ. of Singapore, Singapore; Rathor, M. N.; Ti, H. C.; Chemical Engineering Journal; Jun, 1997; ISSN 1385-8947; Volume 67, no. 3, pp. 205-214; In English; Copyright; Avail: Issuing Activity

A novel external-loop airlift reactor in combination with a fluidized bed was proposed in this work. The gas sparger located in the upper section of the riser allowed the heavy solid particles to fluidize in the lower section of the riser, and also separated the gas-liquid and solid-liquid contact. The reactor, with high degree of design flexibility, is expected to handle fragile cells which are shear-sensitive. Studies were carried out using three different types of solid particles with three different solid loading in the reactor. The solids-free standard external-loop airlift reactors with different H/D ratio were also investigated for comparison. The gas holdup, liquid circulation velocity, liquid mixing time, and the fluidized-bed expansion were studied. Several models reported were applied to the hydrodynamic performance of the reactor. The oxygen transfer in the liquid was also measured and the k(sub L)a(sub L) value was obtained using a dynamic technique. Empirical correlations describing the proposed reactor are presented in this paper and very good agreement could be found.

Author (EI)

Air Transportation; Mass Transfer; Fluidized Bed Processors; Chemical Reactors; Hydrodynamics; Mixing

19980060926

Condensing heat transfer characteristics of aluminum flat tube

Chang, Yeon-Pun, Chung Yuan Christian Univ., Taiwan, Province of China; Tsai, Rueyyih; Hwang, Jiin-Wen; Applied Thermal Engineering; Nov, 1997; ISSN 1359-4311; Volume 17, no. 11, pp. 1055-1065; In English; Copyright; Avail: Issuing Activity

Aluminum brazed heat exchangers are used widely in automobile air conditioning systems. Usually, this kind of heat exchanger is made of a flat tube with several independent passages in the cross-section, and formed into a serpentine or a parallel flow geometry. In these heat exchangers, a multitude of corrugated fins with louvers are inserted into the gaps between flat tubes. As a result of their high performance, some companies are starting to use extruded brazed aluminum heat exchangers in heating, ventilating and air conditioning applications. The purpose of this investigation is to provide the basic condensing heat transfer data for the extruded aluminum flat tube. Four different flat tubes and one micro fin tube were employed in this series of experimental studies. HFC-134a and HCFC-22 were the working fluids used. Our results were closest to Shah’s correlation in the low quality region.

Author (EI)

Heat Transfer; Heat Pipes; Heat Transfer Coefficients; Aluminum; Pipes (Tubes); Fins; Refrigerants

19980061818

Forced response analysis of gas turbine rotor blades using CFD-based aeroelastic tools

Kruse, Marlin J., AlliedSignal Engines, USA; Liu, Jong S., AlliedSignal Engines, USA; Marenghi, Yves G., AlliedSignal Engines, USA; Eick, Christopher D., AlliedSignal Engines, USA; 1997, pp. 403-409; In English

Contract(s)/Grant(s): NAS3-27752; Copyright; Avail: Aeroplus Dispatch

Integration of CFD and structural dynamics codes is critical to the advancement of turbomachinery designs. This paper describes the successful integration of the CFD code UNSFLO with the structural dynamics code ANSYS for a case study rotor. to evaluate the software combination, AlliedSignal Engines initiated a program to compare experimental observations from a set of high-pressure turbine tests to analytical predictions from UNSFLO and ANSYS. The rotor under investigation exhibited significant blade vibratory response due to pressure wakes from upstream stator vanes. Experimental data, collected on two stator-rotor

configurations, indicates dramatic strain reductions when the axial space between the stator and rotor blades is increased. Forced response analyses, which compare favorably to the experimental data, indicate a 90 percent reduction in vibratory strain levels.
Author (AIAA)
Gas Turbine Engines; Rotor Blades; Dynamic Structural Analysis; Fatigue Life; Vibration Tests

19980061831
Forced response prediction of gas turbine rotor blades
Hilbert, Gary R., Pratt & Whitney, USA; Ni, Ron-Ho, Pratt & Whitney, USA; Takahashi, Ronald K., Pratt & Whitney, USA; 1997, pp. 491-498; In English; Copyright; Avail: Aeroplus Dispatch

An analytical forced response prediction system is used to predict turbomachinery airfoil vibratory stress amplitudes. The forced airfoil vibration can be caused by time-dependent (unsteady) aerodynamic loads due to interaction with the flow field from neighboring airfoils rows, such as shocks, wakes, or pressure waves, or due to self-induced unsteady aerodynamics such as vortex shedding and unsteady tip vortices. The amplitude of the forced response is of particular interest when the frequency of the time-dependent unsteadiness is close to the natural frequency of the forced airfoil. Under this condition, the airfoil is at or near resonance, and vibratory stress can exceed the material capability, causing HCF failures. The airfoil forced response prediction system presented here combines structural static and dynamic analysis with steady and unsteady CFD analysis in an iterative coupled solution to the aeroelastic problem.
Author (AIAA)
Gas Turbine Engines; Rotor Blades; Forced Vibration; Dynamic Response; Airfoil Oscillations; Unsteady Aerodynamics

19980062534
Shape control of laminate plate containing piezoelectric patches
Lin, Xi-Qiang, National Univ. of Defense Technology, China; Ren, Jun-Guo, National Univ. of Defense Technology, China; Li, Dong-Xu, National Univ. of Defense Technology, China; 1998, pp. 270-275; In English; Copyright; Avail: Aeroplus Dispatch

Future technologies in microsensing, microactuation, active changes in shape of airfoils justify and necessitate a comprehensive study of piezo actuators for shape control of structures. In this paper, via application of the Heaviside function, equations governing the laminate plate that possess spatially distributed piezoelectric patches are obtained, and an analytic solution method is given. On the basis of these equations, an optimal static shape control model is established. Using the collocation point method combined with the genetic algorithm, the optimal locations and scales of these piezoelectric patches are selected, and the voltages are determined. Numerical examples are presented to illustrate the procedure of the optimizing algorithm. It is shown that the control model presented here is very efficient and valuable for the shape control of these complex structures.
Author (AIAA)
Shape Control; Laminates; Airfoils; Plate Theory

19980062622
On modal testing of flexible rotors for unbalance identification
Kreuzinger-Janik, T., Kassel, Univ., Germany; Irretier, H., Kassel, Univ., Germany; 1998, pp. 1533-1539; In English; Copyright; Avail: Aeroplus Dispatch

For the identification of the unbalance distribution of flexible rotors a method was developed which is based on the modal expansion of the frequency response function matrix. Basically, this expansion can be found either by a numerical calculation which normally requires a modal updating procedure for sufficient accuracy or by experimental results. In both cases an appropriate modal testing technique is needed for experimental modal analysis of the rotor. A rotor test rig is presented which was designed for rotordynamic experiments, in particular for modal analysis and unbalance identification. The rotor is excited by a noncontact magnetic exciter which can be placed in various positions on the rotor. Both, the exciting force as well as the displacement of the rotor at the driving point are directly measured in the exciter. The response of the rotor is detected by several noncontact laser sensors and eddy current pickups along the rotor. The frequency response function matrix is determined from the exciting response data and by the orthogonal polynomial phase seperation technique the modal parameters are extracted. Related results are presented and discussed.
Author (AIAA)
Modal Response; Flexible Bodies; Rotors; Excitation

19980062644
Updating industrial models under a general optimization environment
Pascual, R., Liege, Univ., Belgium; Golinval, J. C., Liege, Univ., Belgium; Berthillier, M., SNECMA, France; Despres, T.,

SNECMA, France; 1998, pp. 1326-1332; In English; Copyright; Avail: Aeroplus Dispatch

This paper discusses the tuning of FE models using experimental measures and the use of appropriate cost functions that express the discrepancies between the analytical and experimental models in the modal space. The technique is successfully implemented in a general-purpose optimization package used for industrial applications. This environment allows an open choice of the design parameters, and to perform easily parametric studies, statistical analyses, multi-objective optimizations.

Author (AIAA)

Upgrading; Optimization; Finite Element Method; Aircraft Engines; Airframes

19980062689

Complex modal analysis and interpretation for rotating machinery

Kessler, C., USAF, Wright Lab., USA; Kim, J., Cincinnati, Univ., USA; 1998, pp. 782-787; In English; Copyright; Avail: Aeroplus Dispatch

The use of complex variables to represent rotating vectors which describe natural modes and forced responses in rotor dynamic systems is investigated. It is shown that general planar motions and forces can be represented as the linear superposition of forward and backward rotating vectors. It is also shown that this allows frequency response functions to implicitly include directionality. Homogeneous solutions of the complex formulation lead to clear physical definitions of forward and backward modes. Substitution of general forms of response and excitation, a process analogous to that in the classical vibration problem, is shown to result in directional frequency response functions (dFRFs) which provide modal directivity and separation in the frequency domain. The paper establishes the fact that dFRFs relate the forward and backward components of the complex displacement and excitation functions. All concepts in the procedure are directly traceable to real measurable signals, which indicates that complex vibration analysis is a generalized case of classical vibration analysis of nonrotating structures.

Author (AIAA)

Modal Response; Rotating Bodies; Vibration Measurement; Free Vibration; Rotors

19980062703

Evaluation of model reduction methods using modal test data

Chung, Y. T., Boeing Co., USA; 1998, pp. 660-666; In English; Copyright; Avail: Aeroplus Dispatch

Model reduction algorithms used to generate the test analysis model for direct correlation with modal survey data are evaluated for accuracy using measured modal test data. Using test data allows some variables, such as the instrumentation calibration uncertainty and the noise contained in the dynamic testing environments that normally are not easy to simulate, to be included in the assessment. Five commonly used model reduction methods, Guyan (static) reduction, improved reduced system method, modal reduction, hybrid reduction, and Craig-Bampton reduction, are evaluated based on their performances on the mass orthogonality matrix and the cross orthogonality matrix. The selection of the mass orthogonality and the cross orthogonality matrices as the evaluation parameters is based on the fact that only the reduced mass matrix is deteriorated by the reduction transformation matrix. The evaluation results of three Space Station hardware modal survey test data sets indicate that the Guyan reduction method provides the better data correlation.

Author (AIAA)

Modal Response; Aerodynamic Loads; Space Stations; Control Moment Gyroscopes

19980062716

Creating and verifying a research-grade simply-supported cylinder with applications to aerospace structures

Niezrecki, Christopher, Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Cudney, Harley H., Virginia Polytechnic Inst. and State Univ., Blacksburg; 1998, pp. 1240-1249; In English

Contract(s)/Grant(s): F49620-93-1-0280; F49620-94-1-0346; Copyright; Avail: Aeroplus Dispatch

In many aerospace and structural applications, idealized cylinders are used to approximate more complex structures such as airplane fuselages and rocket payload fairings. Many authors have created sophisticated models of the structural response of cylinders excited by a variety of actuators. However seldom are these models verified experimentally. None of the models created to describe the response of a simply-supported (SS) cylinder have ever been verified. In this work several different boundary conditions are created to approximate an ideal SS cylinder. The different boundary conditions tested are described and compared with finite element analysis (FEA) and with an impedance based analytical model for a piezoelectric actuator (PZT) exciting a SS cylinder. The work presented describes the steps taken in creating a physical boundary condition which approximates the ideal boundary condition for a SS cylinder. The results indicate that the created physical boundary condition resembles the ideal SS boundary condition. The structural response computed by the impedance model is also shown to agree with the experiment and with the

FEA. The results can be used to create other experimental SS cylinders and will be used at Virginia Tech to determine the feasibility of applying piezoelectric actuators to control rocket payload fairings vibrations.
Author (AIAA)
Spacecraft Structures; Cylinders; Fuselages; Fairings; Finite Element Method

19980062936
Wireless passive IDT strain microsensor
Varadan, Vasundara V., Pennsylvania State Univ., University Park, USA; Varadan, Vijay K., Pennsylvania State Univ., University Park; Bao, Xiaoqi, Pennsylvania State Univ., University Park; Ramanathan, Srinivasan, Pennsylvania State Univ., University Park; Piscotty, Daniel, Pennsylvania State Univ., University Park; Smart Materials and Structures; Dec. 1997; ISSN 0964-1726; Volume 6,, no. 6, pp. 745-751; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the experimental results of wireless passive IDT strain microsensors, which consist of interdigital transducers (IDTs) on piezoelectric wafers to transmit and receive surface acoustic waves. By connecting the IDTs to a small microwave antenna, the IDT microsensors are wirelessly readable by a microwave reading system. The sensors are calibrated on a static cantilever beam and used to measure the dynamic strain of a vibrating beam wirelessly. The calibrated sensitivity compares reasonably with the theoretical estimation. The feasibility of compensating for temperature variations and reading multiple sensors simultaneously and the ability to combine the sensor and the wireless recognition systems are discussed.
Author (AIAA)
Rotary Wings; Rotor Blades; Strain Gages; Interdigital Transducers; Surface Acoustic Wave Devices

19980063707
Keeping step motors from stalling
Nordquist, Jack, Industrial Devices Corp., USA; Power Transmission Design; Nov, 1997; ISSN 0032-6070; Volume 39, no. 11, pp. 55-57; In English; Copyright; Avail: Issuing Activity

One of the major causes of step motor stalling is a phenomenon called resonance. As motors accelerate and decelerate, their shafts typically oscillate, causing variations in shafts speed and position. These variations require additional motor torque to quell, thus reducing the available torque for the commanded move. Several methods are effective to damp resonance. These include: inserting elastomeric couplings; filling the motor with viscous ferrofluids; and using a large seismic mass coupled to the rotor via viscous fluid or elastic solid.
EI
Stepping Motors; Damping; Torque; Rotors; Winding; Resonant Frequencies

19980063920
Overall volumetric oxygen transfer coefficient and optimal geometry of airlift tube reactor
Bekassy-Molnar, E., Univ. of Horticulture and Food, Hungary; Majeed, J. G.; Vatai, Gy.; Chemical Engineering Journal; Jul, 1997; ISSN 1385-8947; Volume 68, no. 1, pp. 29-33; In English; Copyright; Avail: Issuing Activity

Absorption of oxygen from air into distilled water in a new type of airlift tube reactor has been investigated at the 1.3 1 scale. Results of this mass transfer study together with hydrodynamic results provide a means of optimizing the geometrical parameters of the reactor. The overall volumetric oxygen transfer coefficient (K(sub L)a) was measured as a function of the gas velocity in reaction tubes, the liquid hold-up in the reactor expressed in terms of liquid height, the cross-sectional area ratio of the recycle-to-reaction tubes (A(sub rec)/A), the liquid temperature and specific power input. The K(sub L)a was measured using a dynamic gassing method with polarographic measurements of dissolved oxygen.
Author (EI)
Air Transportation; Mass Transfer; Oxygen; Absorptivity; Gases; Chemical Reactors; Polarography

19980063981
Resonance capture in a three degree-of-freedom mechanical system
Quinn, D. Dane, Univ. of Akron, USA; Nonlinear Dynamics; Dec, 1997; ISSN 0924-090X; Volume 14, no. 4, pp. 309-333; In English; Copyright; Avail: Issuing Activity

We study the phenomena of resonance capture in a three degree-of-freedom dynamical system modeling the dynamics of an unbalanced rotor, subject to a small constant torque, supported by orthogonal, linearly elastic supports, which is constrained to move in the plane. In the physical system the resonance exists between translational motions of the frame and the angular velocity of the unbalanced rotor. These equations, valid in the neighborhood of the resonance, possess a small parameter epsilon which is related to the imbalance. In the limit epsilonyields 0, the unperturbed system possesses a homoclinic orbit which separates

bounded periodic motion corresponding to resonant solutions from unbounded motion which corresponds to solutions passing through the resonance. Using a generalized Melnikov integral, we characterize the splitting distance between the invariant manifolds which govern capture and escape from resonance for epsilon does not equal 0. It is shown that as certain slowly varying parameters evolve, the separation distance alternates sign, indicating that both capture into, and escape from resonance occur. We find that although a measurable set of initial conditions enter into a sustained resonance, as the system further evolves the orientation of the manifolds reverses and many of these captured solutions will subsequently escape.
Author (EI)
Degrees of Freedom; Rotors; Resonance; Torque; Elastic Properties

19980064830

Relating turbulence to wind turbine blade loads - Parametric study with multiple regression analysis
Kashef, Tina, Stanford Univ., USA; Winterstein, Steven R., Stanford Univ., USA; 1998, pp. 273-281; In English
Report No.(s): AIAA Paper 98-0057; Copyright; Avail: Aeroplus Dispatch

Different wind parameters are studied to find a set that is most useful in estimating fatigue loads on wind turbine blades. The histograms of rainflow-counted stress ranges are summarized through their first three statistical moments, and regression analysis is used to estimate these moments in various wind conditions. A systematic method of comparing the ability of different wind parameters to estimate the moments is described, and results are shown for flapwise loads on three horizontal axis wind turbines (HAWTs). In the case of two of these turbines, the stress ranges are shown to be highly correlated with a turbulence measure obtained by removing a portion of the LF content of the wind.
Author (AIAA)
Wind Turbines; Turbine Blades; Turbulence Effects; Regression Analysis; Aerodynamic Loads; Fatigue Life

19980064834

Damage measurements on the NWTC direct-drive, Variable-Speed Test Bed
Sutherland, Herbert J., Sandia National Labs., USA; Carlin, Palmer W., National Renewable Energy Lab., USA; 1998, pp. 315-322; In English
Contract(s)/Grant(s): DE-AC04-94AL-85000; DE-AC36-83CH-10093
Report No.(s): AIAA Paper 98-0064; Copyright; Avail: Aeroplus Dispatch

The NWTC (National Wind Technology Center) Variable-Speed Test Bed turbine is a three-bladed, 10-m, downwind machine that can be run in either fixed-speed or variable-speed mode. In the variable-speed mode, the generator torque is regulated, using a discrete-stepped load bank to maximize the turbine's power coefficient. At rated power, a second control loop that uses blade pitch to maintain rotor speed becomes active. The load bank controller continues essentially as before, i.e., using the load bank to maintain either generator torque or (optionally) generator power. In this paper, we use this turbine to study the effect of variable-speed operation on blade damage. Using time-series data obtained from blade flap and edge strain gauges, the load spectrum for the turbine is developed using rainflow counting techniques. Miner's rule is then used to determine the damage rates for variable-speed and fixed-speed operation. The results illustrate that the variable speed controller algorithm used with this turbine introduces relatively large load cycles into the blade that significantly reduce its service lifetime, while power production is only marginally increased.
Author (AIAA)
Wind Turbines; Test Equipment; Turbine Blades; Rotor Speed; Aerodynamic Loads

19980065247

Soft body impact damage tolerance of laminated and 3D woven composites
Weeks, Craig A., Pratt & Whitney, USA; Bertke, Robert S., Dayton, Univ., USA; Laber, Mark W., Dayton, Univ., USA; 1997, pp. 169-186; In English
Contract(s)/Grant(s): MDA972-94-3-0029; Copyright; Avail: Aeroplus Dispatch

The Affordable Composite for Propulsion (ACP) program is investigating material designs and manufacturing processes which produce affordable and structurally acceptable parts for turbofan engine applications. In order to evaluate material architectures for engine structures susceptible to bird impact events, soft body impact tests were performed on laminated and 3D woven composite flat panels. Material architecture variables such as graphite/glass hybridization, stitching and type of stitch fiber for laminated composites, and ply-to-ply and through thickness interlock weaves for 3D materials were investigated. The primary test results of interest were damage resistance (velocity or energy to initiate measurable damage) and damage tolerance (resistance of the panel to propagation of existing damage). The results of these experiments are presented, and the behavior of the various

material architectures are compared and contrasted. Material architecture variables which increase the soft body impact damage resistance and tolerance are noted.
Author (AIAA)
Impact Damage; Laminates; Woven Composites; Three Dimensional Composites; Turbofan Engines; Failure Modes

19980065448

New inspection tools for aging aircraft

Wincheski, Russell A., NASA Langley Research Center, USA; Namkung, Min, NASA Langley Research Center, USA; Aerospace America; Mar. 1998; ISSN 0740-722X; Volume 36, no. 3, pp. 27-29; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of NASA's development of a highly effective class of EM field-based metallic aircraft structure nondestructive inspection probes. One form of the probe is hand-held and extremely accurate in the fatigue crack monitoring activities required by aging aircraft.
AIAA
Electromagnetic Fields; Aircraft Structures; Nondestructive Tests

19980065466

Wind loads and wind-induced dynamic behavior of a single-layer latticed dome

Uematsu, Yasushi, Tohoku Univ., Japan; Yamada, Motohiko; Inoue, Akira; Hongo, Takeshi; Journal of Wind Engineering and Industrial Aerodynamics; Mar, 1997; ISSN 0167-6105; Volume 66, no. 3, pp. 227-248; In English; Copyright; Avail: Issuing Activity

Wind loads and wind-induced dynamic behavior of a rigidly jointed single-layer latticed dome with a long span is studied. The wind pressure are measured simultaneously at many points on a dome model in a turbulent boundary layer which simulated the natural wind over typical urban terrain. The dynamic response of nine latticed domes with a span of 120m is analyzed in the time domain.
EI
Dynamic Characteristics; Loads (Forces); Turbulent Boundary Layer; Wind Tunnel Tests; Aerodynamics; Wind (Meteorology); Wind Effects; Dynamic Response

19980065940

Printed circuits in the 21st century

Trinite, George, Elexsys Int. Inc., USA; Printed Circuit Fabrication; Nov, 1997; ISSN 0274-8096; Volume 20, no. 11, pp. 52, 54, 56, 58-59; In English; Copyright; Avail: Issuing Activity

The printed circuit board (PCB) of the next century will be what the consumer is demanding: lighter, smaller, thinner, and with increased performance, all at cheaper price. Between now and the end of this century the greatest growth will be in boards of less than one square inch. The quad flat pack (QFP) will be replaced by the ball grid array (BGA) in the near future and it will be replaced by the chip scale package (CSP) which will then be replaced by the flip chip. During this transition of packaging technologies, the PCB will begin to use laser formed micovias at first, then as the number of microvias per panel increases, the photodefineable dielectric build-up process will become the microvia of choice.
EI
Printed Circuits; Tabs (Control Surfaces); Manufacturing; Electronic Packaging; Electronic Equipment; Integrated Circuits; Supports

19980066371

Periodic, quasi-periodic and chaotic vibrations of a rub-impact rotor system supported on oil film bearings

Chu, Fulei, Tsinghua Univ., China; Zhang, Zhengsong; International Journal of Engineering Science; Aug-Sep, 1997; ISSN 0020-7225; Volume 35, no. 10-11, pp. 963-973; In English; Copyright; Avail: Issuing Activity

Vibration characteristics of a rub-impact rotor system supported on oil film bearings are investigated. Oil film forces are obtained from the short bearing approximation. Elastic impact and the Coulomb type of frictional relationship are assumed in the analysis. A nonlinear mathematical model with piecewise linear stiffness is used. Rotating speed, the system damping and unbalance are used as control parameters to observe various forms of periodic, quasi-periodic and chaotic vibrations. Four different routes to and out of chaos, that is, periodic, quasi-periodic, intermittent and period doubling bifurcation routes, are found. It is

shown that the system can exhibit very rich types of periodic, quasi-periodic and chaotic vibrations. These forms of vibrations and relevant phenomena can be effectively used to diagnose the rub-impact fault in rotating machinery.
Author (EI)
Rotors; Vibration Mode; Approximation; Bearings; Mathematical Models

19980066760
Shephard's unmanned vehicles handbook 1998
1997; In English
Report No.(s): ISSN 1365-6546; Copyright; Avail: Aeroplus Dispatch

The present volume presents a comprehensive survey of autonomous and remotely piloted unmanned vehicles (UVs) for military and police surveillance and weapons-carrying applications. The UVs presented encompass aircraft, wheeled and tracked land vehicles, and underwater vehicles. Performance specifications are given.
AIAA
Pilotless Aircraft; Remotely Piloted Vehicles; Surface Vehicles; Underwater Vehicles

19980066891
Efficiency of the Menter correction for steady and unsteady no-smooth flows
Francescatto, Jerome, Dassault Aviation, France; Dervieux, Alain, Dassault Aviation, France; Ravachol, Michel, INRIA, France; 1997, pp. 399-408; In English; Copyright; Avail: Aeroplus Dispatch

The Menter correction for turbulent viscosity is studied in combination with a k-epsilon model with a two-layer treatment of a boundary layer of the Chen-Patel type and the wall laws approach. This correction applies especially when flow is nonsmooth close to the wall; this happens in the case of shocks or separation induced by angular walls. This study is presented for airfoil transonic flows and the unsteady flow past a square cylinder.
Author (AIAA)
Steady Flow; Turbulent Diffusion; Unsteady Flow; K-Epsilon Turbulence Model; Airfoil Profiles

19980066902
Flow visualisation and boundary layer investigations of revolving objects at high Reynolds numbers
Mann, B. S., Bharat Heavy Electricals, Ltd., India; 1997, pp. 557-564; In English; Copyright; Avail: Aeroplus Dispatch

Detailed 2D boundary layer profiles of simple circular objects and airfoils at different Reynolds numbers under revolving condition are described. The boundary layer profile of an airfoil wing whose data in flight condition is available was compared under revolving conditions. Revolving of the objects was carried out using a rotating disk apparatus. The boundary layer growth under revolving conditions is appreciably less due to favorable pressure gradients arising from centrifugal forces. The boundary layer growth and its separation on various objects are described in detail. This technique can be applied for better conceptual understanding of the boundary layer growth of rotating machinery.
Author (AIAA)
Two Dimensional Boundary Layer; Flow Visualization; High Reynolds Number; Airfoil Profiles; Rotating Disks

19980066904
Planform structure of turbulent free convection on horizontal surfaces
Theerthan, S. A., Indian Inst. of Science, India; Arakeri, Jaywant H., Indian Inst. of Science, India; 1997, pp. 573-580; In English; Copyright; Avail: Aeroplus Dispatch

The planform structure of turbulent free convection over a heated horizontal surface has been visualized and analyzed for different boundary conditions at the top and for different aspect ratios, for flux Rayleigh numbers ranging from 10 exp 8 - 10 exp 10. The different boundary conditions correspond to Rayleigh-Benard convection, open convection with evaporation at the top and with an imposed external flow on the heated boundary. Without the external flow the planform is one randomly oriented line plume. At large Ra, these line plumes seem to align along the diagonal, persumably due to a large-scale flow along as visualized in the side view. When the external flow is imposed, the line plumes clearly align in the direction of external flow. Flow visualization reveals that at these Ra, the shear tends to break the plumes which otherwise would reach the opposite boundary.
Author (AIAA)
Wing Planforms; Turbulent Flow; Free Convection; Horizontal Orientation; Flow Visualization; Benard Cells

19980066917

Local and global enhancement of turbulent heat and mass transfer by swirl

Fiebig, Martin, Bochum, Ruhr-Univ., Germany; Weber, Dirk, Bochum, Ruhr-Univ., Germany; 1997, pp. 845-856; In English; Copyright; Avail: Aeroplus Dispatch

Swirl in the form of counterrotating longitudinal vortices is generated experimentally in a dedicated wind tunnel by an array of rectangular wing-type vortex generators (WVGs) attached to one channel wall. For comparison, the corresponding plane and cross ribbed channel flows are considered. Velocity fluctuations, turbulence level, and pressure are measured. Local and global heat transfer distributions are deduced from the local mass transfer measurements by the ammonium absorption method. The WVG height is 50 and 25 percent of the channel height, and the WVG angle of attack is 45. The Reynolds number is varied from laminar to turbulent flow. The critical Reynolds number is reduced by more than an order of magnitude compared to plane channel flow. Heat transfer is enhanced by swirl and the large amplitude velocity fluctuations. The heat transfer is lowest in the down-wash regions of the vortices. The heat transfer enhancement increases with Reynolds number and reaches several 100 percent globally for Reynolds number 3000.

Author (AIAA)

Turbulent Heat Transfer; Mass Transfer; Swirling; Vortex Generators; Counter Rotation; Rectangular Wings

19980067020

Low-cost processing of moderately-loaded composite bulkheads for aircraft structures

Cathcart, Robert D., Lockheed Martin Tactical Aircraft Systems, USA; Faoro, Anthony A., Lockheed Martin Tactical Aircraft Systems, USA; Guzzardo, Bryan J., Lockheed Martin Tactical Aircraft Systems, USA; Masse, Allen R., Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 254-262; In English; Copyright; Avail: Aeroplus Dispatch

Lockheed Martin Tactical Aircraft Systems (LMTAS) has been developing a low-cost composite manufacturing approach utilizing Cure-Form processing and 3D preform technology since 1991 as a means to reduce the recurring cost of component fabrication. Cure-Form processing reduces requirements for both operator skill level and touch labor by using flat laminate fabrication and diaphragm forming to produce contoured structures; this process provides repeatable, near-net thickness laminates by introducing an intermediate hot debulk. Cure-Form processed laminates are critical for cocured and unitized structures. Recently, 3-dimensional preform designs have been improved by LMTAS and weaving suppliers such that high out-of-plane loads are transferred through the web sections of bulkhead components. In addition, soft tooling has been developed that provides necessary stiffness for unitized structures, and yet is compliant to produce porosity-free joints. LMTAS's preform technology, integrated with Cure-Form processing and soft tooling approaches, has enabled the design of composite structures that replace traditional metallic structures in order to save weight, improve quality, and be cost-effective.

Author (AIAA)

Low Cost; Composite Structures; Bulkheads; Aircraft Structures; Preforms; Mechanical Properties

19980067022

The electron beam cure of fiberglass/epoxy prepregs

Framer, Jeffrey D., USAF, Wright Lab., USA; Janke, Christopher J., Oak Ridge National Lab., USA; Lopata, Vincent J., Atomic Energy of Canada, Ltd., Pinawa; 1997, pp. 274-288; In English; Copyright; Avail: Aeroplus Dispatch

Recently developed epoxy resin prepregs were electron beam cured and experimentally explored to determine their suitability for use in an aerospace-quality aircraft component. There were two major goals for this program. The first was to determine whether the electron beam-curable prepregs were capable of meeting the requirements of the U.S. Air Force T-38 supersonic jet trainer composite windshield frame. The T-38 windshield frame is currently manufactured using an aerospace-grade prepreg composed of 6781 S-2 woven fiberglass and various 250 F thermally-cured epoxies. The second goal was to develop the lowest cost hand layup and debulk process that could be used to produce laminates with acceptable properties. The laminate properties examined to determine prepreg suitability include laminate mechanical and analytical properties at room and elevated temperatures, prepreg tackiness, prepreg out-time capability, and the debulk requirements needed to achieve these properties. Four resins and three fiber sizings were experimentally examined using these criteria. One epoxy and one fiber sizing were found to have suitable characteristics in each of these categories and were later chosen for the manufacture of the T-38 windshield frame. This experimental study shows that, by using low-cost debulk and layup processes, the electron beam-cured prepreg mechanical and analytical properties are in the range of comparable thermally cured prepregs.

Author (AIAA)

Electron Beams; Curing; Epoxy Matrix Composites; Glass Fibers; Prepregs; Aircraft Structures

19980067028

Adhesive bondline study using design of experiment technique

Bonnet, Brett, U.S. Navy, Naval Air Warfare Center, USA; Mehrkam, Paul, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 354-365; In English; Copyright; Avail: Aeroplus Dispatch

The Navy has a requirement to perform bonded structural composite repairs on aircraft with use of vacuum bag pressure. The resulting adhesive bondline must be void free to ensure sufficient bond strength and inspection of the repair by nondestructive means. Magnobond 6363 two part epoxy paste adhesive was developed by the Naval Air Warfare Center Aircraft Division, Patuxent River, MD (NAWCADPAX) for field bonded composite repairs. During the development process for bonded composite repairs utilizing Magnobond 6363, problems were encountered with bondline thickness control and porosity content that were related to process variations applied by each user. In response to this problem, NAWCADPAX conducted an evaluation of the most significant processing factors using a Taguchi Design of Experiment (DOE) approach. This experimental design technique was applied to minimize the number of experiments required in determining the effect of each of the significant factors on bondline thickness and porosity. The approach was effective in optimizing the evaluation process leading to the development of a preferred process for composite repairs utilizing Magnobond 6363.

Author (AIAA)

Adhesive Bonding; Composite Structures; Aircraft Structures; Epoxy Resins

19980067037

Different lay-up procedure influences on final porosity distribution in a carbon/toughened epoxy structural composite system

Shim, Sang-Beom, MIT, USA; Seferis, James C., Washington, Univ., Seattle; Hudson, William; 1997, pp. 495-504; In English; Copyright; Avail: Aeroplus Dispatch

Voids are known to degrade the final mechanical performance of aircraft structural composites. This research focused on understanding void generation in composite structure caused by different lay-up procedures. The amount of voids was characterized via ultrasonic C-scan analysis, density measurements, and optical microscopy, with the objective of integrating the results of the three different void content characterization methods. Void distribution results obtained by ultrasonic C-scan analysis were consistent with those of density measurements. The void content distribution caused by a metal plate was observed, and this behavior was modeled into a caul plate number (CPN) definition. Through a vast array of composite fabrication and void content investigation, appropriate lay-up techniques were found to be indispensable in reducing the void content in the composite structure. Collectively, void formation in the composite structure during autoclave process was attributed to not only inherent materials properties but also processing conditions.

Author (AIAA)

Lay-Up; Porosity; Graphite-Epoxy Composites; Aircraft Structures; Prepregs; Composite Structures

19980067055

A novel moldable phenolic sandwich composite with outstanding fire and mechanical performance

Katz, Steven G., ISORCA, Inc., USA; Bastone, Andrew L., ISORCA, Inc., USA; 1997, pp. 761-765; In English; Copyright; Avail: Aeroplus Dispatch

ISORCA's Alba-Core, a patented structural core material for sandwich composites, is a new class of materials. It is made primarily of glass microspheres tightly bonded together with a small amount of resin, and it provides excellent mechanical properties for structural applications. The material can easily be molded to shape. The addition of a special additive makes it a closed cell structure, decreasing permeability, thermal conductivity, and moisture absorption. A variety of resins can be used, but with phenolic resin, the system has outstanding fire and smoke performance, and has passed the FAA requirements for aircraft compartment interiors.

Author (AIAA)

Phenolic Resins; Sandwich Structures; Mechanical Properties; Fire Prevention; Foams; Aircraft Accidents

19980067109

Application of adaptive variable neural network to aeroengine failure diagnosis

Xia, Shousheng, Northwestern Polytechnical Univ., China; Fan, Siqi, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 367-370; In Chinese; Copyright; Avail: Aeroplus Dispatch

A new adaptive variable neural network is developed according to the inner product feature of a sample space. This method does not need to iterate learning. Its self-learning rate is fast, accuracy is high, and it is able to change its structure when a new sample is produced. It has been applied to an aeroengine starting system; its accuracy in failure diagnosis is superior to that of

the original system, and maintenance work is cut down. Moveover it has the capability of real-time failure diagnosis, which opens up bright prospects for its application.
Author (AIAA)
Aircraft Engines; Engine Failure; Adaptive Control; Neural Nets; Engine Control

19980067111

Numerical simulation of two-dimensional flowfield in particle separator

Hou, Lingyun, Northwestern Polytechnical Univ., China; Yan, Chuanjun, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 374-376; In Chinese; Copyright; Avail: Aeroplus Dispatch

A numerical simulation of the two-dimensional, viscous and axisymmetric flowfield and various diameter particle trajectories in an inertial Inlet Particle Separator (IPS) has been completed. For complex boundaries, a grid system of nonorthogonal body-fitted coordinates is generated, which is ideally suited to this case. For split flow, multiply connected regions are transferred to a simply connected region. A SIMPLEC algorithm for a full Navier-Stokes solver in generalized curvilinear coordinates is applied to calculate the viscous flow in the IPS. Finally, particle trajectories in the above viscous flowfield and separator efficiency are obtained. Good agreement between the experimental data and predicted results indicates that the presented procedure and the program may help in the development and design of future high performance inlet particle separator.
Author (AIAA)
Helicopter Engines; Engine Inlets; Particle Motion; Viscous Flow; Separators; Two Dimensional Flow

19980067117

Comparison between two kinds of conventional labyrinth

Wu, Dingyi, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 397-400; In Chinese; Copyright; Avail: Aeroplus Dispatch

Straight-through and stepped labyrinths are often used in aircraft engines. According to large amounts of experimental data, the empirical formulas of mass flow factor for the two kinds of labyrinth have been provided which are superior to theoretical formulas due to various corrections. The seal characteristics of the two kinds of labyrinth were compared and analyzed in detail so that their features and reasonable conditions of their application were determined. Finally, new empirical formulas for calculating their critical pressure ratio were also derived.
Author (AIAA)
Aircraft Engines; Engine Parts; Labyrinth Seals; Mass Flow; Critical Pressure; Hermetic Seals

19980067119

Digital simulation of tooth cutting and meshing of spiral bevel gears

Wang, Sanmin, Northwestern Polytechnical Univ., China; Ji, Minggang, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 404-406; In Chinese; Copyright; Avail: Aeroplus Dispatch

The conventional methods for determining the tooth geometry and tooth contact of spiral bevel gears are based on differential geometries of rigid body movement and consequently make the description of tooth surface and analysis of tooth contact behavior very complicated. In this paper, the authors develop a digital simulation method for tooth cutting and meshing of spiral bevel gears. A numerical model of tooth surfaces is set up by digital simulation of tooth cutting. The analysis of tooth contact behavior is completed with a numerical model of tooth surfaces. Solution of the meshing equation in conventional methods is replaced by minimizing the normal distance between points on the tooth surfaces in our method. The results of a digital simulation for the spiral bevel gears used in a Chinese aeroengine show that the presented method describes the tooth shape and tooth contact characteristics more conveniently and efficiently and can determine optimal cutting adjustment parameters for obtaining spiral bevel gears with good contact quality.
Author (AIAA)
Gear Teeth; Surface Geometry; Spirals; Sliding Contact; Metal Cutting; Aircraft Engines

19980067120

Fretting fatigue of dovetail joint under combined cyclic loading

Xi, Qi, Yancheng Polytechnical Inst., China; Journal of Aerospace Power; Oct. 1997; ISSN 1000-8055; Volume 12, no. 4, pp. 407-409; In Chinese; Copyright; Avail: Aeroplus Dispatch

The state-of-the-art in research on fretting fatigue of dovetail joints in aircraft engines in China and abroad is reviewed. Stress analysis of a dovetail joint was carried out. Experimental equipment was designed and set up. A number of tentative experiments were conducted. It is confirmed that the experimental technique and equipment can offer a great deal of data for designing.
Author (AIAA)
Aircraft Engines; Joints (Junctions); Fretting Corrosion; Fatigue Life; Cyclic Loads; Engine Design

19980067131

Optical submount development for high-reliability/performance applications

Noddings, Chad, Microelectronics and Computer Technology Corp., USA; Rattan, Scott, Microelectronics and Computer Technology Corp., USA; Russo, Al, Microelectronics and Computer Technology Corp., USA; 1997, pp. 50-53; In English; Copyright; Avail: Aeroplus Dispatch

MCC is currently applying a previously developed and patented optical submount approach for use in high-reliability/performance applications that include space, airframe, and outside telecommunication systems. The optical submount utilizes a novel alignment method integrated with low-cost, few-chip module packaging techniques originally developed for a laminate multichip module (MCM-L) parallel link using vertical cavity surface emitting laser (VCSEL)/optical electrical integrated circuit (OEIC) receiver arrays. This system is now being investigated for use in both single and parallel channel high-reliability/performance applications. The optical submount developments reported in this paper include the following separate but related efforts: a hermetic module development of a VCSEL/OEIC-based parallel optical link, and a single channel fiber optic transmitter and receiver (FOTR) upgrade.
Author (AIAA)
Integrated Circuits; Airframes; Fiber Optics

19980067173

Reliability of structural components under non-periodic inspection and the optimum inspection plan

Chen, Jianqiao, Toyohashi Univ. of Technology, Japan; Takao, Yoshihiro, Kyushu Univ., Japan; Wang, Wenxue, Kyushu Univ., Japan; Kitaoka, Seiichiro, Tottori Univ., Japan; Japan Society for Aeronautical and Space Sciences, Transactions; Nov. 1997; ISSN 0549-3811; Volume 40,, no. 129, pp. 185-195; In English; Copyright; Avail: Aeroplus Dispatch

Fatigue reliability of structural components and the inspection and repair cost under nonperiodic inspection are formulated. An optimal inspection plan in terms of small probability of failure is proposed. A numerical example for crack propagation in fastener holes of airframe components is worked out. It is shown that both significant recoveries of reliability of structural components and great benefit in maintenance economy are obtained by choosing the first inspection time properly.
Author (AIAA)
Structural Reliability; Inspection; Aircraft Structures; Crack Propagation; Fasteners; Airframes

19980067321

Novel technique of vibration control for split Stirling cryocooler with linear compressor

Veprik, Alexander, Ricor, Ltd., Israel; Meromi, Arnon, Ricor, Ltd., Israel; Leshecz, Avraham, Ricor, Ltd., Israel; 1997, pp. 640-651; In English; Copyright; Avail: Aeroplus Dispatch

We present a new, high performance miniature split Stirling cryocooler, model KS29H, with an integral dewar/cold finger, consisting of an electrodynamically driven linear piston compressor and a pneumatically driven expander. The cryocooler was optimized to lift 1-W heat load, applied to an 80 K cold finger, with a reject temperature of 300 K and a net power consumption of 25 W ac at 60 Hz. High cryocooler performance, reasonable pricing, and lower total weight and dimensions were achieved due to the simplified compressor design of unbalanced single piston type. to meet the requirement of low vibration export from the cryocooler to its environment, the compressor unit was suspended on the intermediate frame by means of the soft, lightly damped all-metal planar resilient elements. For the operational safety of cryocooler and its surroundings, the compressor’s excessive axial motion, initiated by the high-level external vibration, was limited by elastomer bumpers with controllable dissipation of impact energy. Bumpers were installed on the intermediate frame with a certain axial clearance permitting impactless compressor operation in any space orientation while the cryocooler was not exposed to the external vibration. The bumped vibroisolation arrangement was optimized to minimize the impact acceleration PEAK and rms levels.
Author (AIAA)
Stirling Engines; Vibration Damping; Cryogenic Cooling; Compressors; Root-Mean-Square Errors

19980067486

Flywheels in hybrid vehicles

Rosen, Harold A., Rosen Motors, USA; Castleman, Deborah R., Rosen Motors, USA; Scientific American; Oct. 1997; ISSN 0036-8733; Volume 27, no. 4, pp. 75-77; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the performance advantages and current development status of a hybrid-propulsion vehicle configuration using a small gas turbine engine as primary power supplier and a high-tech flywheel as energy storage system. The flywheel supplies most of the power for acceleration and absorbs energy otherwise lost during braking; attention is given to a state-of-the-art flywheel design.

AIAA

Electric Hybrid Vehicles; Flywheels; Research and Development; Product Development; Gas Turbine Engines; Electric Automobiles

19980067677

Single chip fault tolerant clock for integrated modular avionics

Truong, T. K., Boeing Commercial Airplane Group, USA; 1997, pp. 2.1-36 to 2.1-44; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents the design and validation testing of a Fault Tolerant Clock ASIC (FTCA) that achieves exact synchronization and features automatic fault detection and reconfiguration capability. The FTCA employs a floating hot spare in addition to the triply redundant core modules to tolerate two sequential faults. We point out the problem of loose synchronization that requires 3m+1 modules for rn faults and illustrate that a 2m+1 system with tightly synchronous inputs can tolerate any malicious fault. The FTCA has on-chip oscillators and features independent channel power supplies, separated I/O pad rings, and isolated core modules with guard rings for latchup protection. Applications for the FTCA include commercial integrated avionics systems, spacecraft, nuclear power plants and other critical applications requiring high reliability and availability.

Author (AIAA)

Chips (Electronics); Fault Tolerance; Clocks; Avionics; Systems Integration; Flight Control

19980067685

Low profile DC-DC power converter for 3-D electronics assembly

Korman, C. S., General Electric Co., USA; Ramakrishnan, S., General Electric Co., USA; Steigerwald, R. L., General Electric Co., USA; Fisher, R. A., General Electric Co., USA; Hennessy, W., General Electric Co., USA; Bicknell, W., General Electric Co., USA; Wojnarowski, R., General Electric Co., USA; Peczalski, A., Honeywell Technology Center, USA; Baier, S., Honeywell Technology Center, USA; 1997, pp. 2.3-21 to 2.3-26; In English; Copyright; Avail: Aeroplus Dispatch

A 130 W/cu in 48 V dc-to-3.3 V dc power converter has been developed for an avionics distributed power system. This converter employs advanced packaging based on the GE-Lockheed Martin High Density Interconnect technology, and new ultralow profile magnetics, to provide a 150 mil high form factor that is consistent with high density 3D electronics packaging.

Author (AIAA)

Power Converters; Avionics; Electronic Packaging; Electric Power Supplies; Direct Current

19980067697

Trade study report for commercial candidates in an embedded avionics unified network

Boggess, Timothy P., Lockheed Martin Co., USA; 1997, pp. 3.3-5 to 3.3-11; In English; Copyright; Avail: Aeroplus Dispatch

Avionics customers want to buy robust systems for as little cost as possible. One way to reduce life cycle cost is to reduce the number of parts and to use as many commercially available parts as possible. to this end, we have been exploring the capability and availability of commercial networks. This report identifies and analyzes commercial based network technologies for avionics unified-network applications. Most of these candidate technologies are still maturing or are just emerging. The intent of this network trade study is to provide a snapshot of the commercial candidates in their current status, and to establish criteria for both near-term and long-term selections.

Author (AIAA)

Embedding; Avionics; Life Cycle Costs

19980067698

Optical communication for advanced avionics systems

Stevens, Rick C., Lockheed Martin Tactical Aircraft Systems, USA; Sauter, Gerald F., Lockheed Martin Tactical Aircraft Systems, USA; Selfritge, Ritch A., Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 3.3-12 to 3.3-19; In English; Copyright;

Avail: Aeroplus Dispatch

This paper briefly describes the optical requirements for advanced avionics systems and the progress towards developing the building blocks necessary to implement these systems. There are five major optical elements required: (1) optoelectronic transmitters and receivers, (2) module high density optical connectors, (3) rack-mounted optical backplane interconnect, (4) rack high-density optical connectors, and (5) environmentally stable fiber ribbon cable. There have been a number of DoD-sponsored individual programs that have individually addressed many of these critical areas. This paper will explore some options available for the unification of multiple technical elements to create an affordable system solution for optically interconnected advanced avionics.

Author (AIAA)

Optical Communication; Avionics; Optical Coupling; Optoelectronic Devices

19980067700

Open systems architecture for integrated RF electronics

Hooks, Dean C., McDonnell Douglas Corp., USA; Rich, Barry A., Lockheed Martin Corp., USA; 1997, pp. 3.4-8 to 3.4-12; In English; Copyright; Avail: Aeroplus Dispatch

The Integrated Sensor System program is defining an Open System Architecture (OSA) for RF electronics, which represent the largest portion of an advanced aircraft's avionics fly-away cost. An integrated architecture is used to reduce costs in a number of ways, including time-sharing, centralization of resources, and reduction of the number of unique module types. The OSA approach extends these cost reductions by simplifying technology insertion, using well-understood standards, and increasing use of commercial hardware and software. This paper describes interim results.

Author (AIAA)

Radio Frequencies; Electronic Equipment; Systems Integration; Avionics; Life Cycle Costs

19980067768

Robust/low cost SSPCs are finally available

Friedman, Steve, ILC Data Device Corp., USA; 1997, pp. 7.3-31 to 7.3-36; In English; Copyright; Avail: Aeroplus Dispatch

New commercial aircraft, satellites, tanks, and various military platforms are turning to solid-state power controllers (SSPCs). Technology has, and will, continue to play a major role in the overall performance and features realized in today's and tomorrow's SSPCs. One technology often overlooked is the packaging. The package has a very important role supporting the mechanical integrity and thermal management in the smallest possible profile. This paper reviews the tradeoffs and factors that can help reduce the overall cost that are available with today's SSPC technology. The paper also focuses on a new packaging concept that will support all of the technical and price/performance issues that are essential to today's power distribution systems.

Author (AIAA)

Robustness (Mathematics); Solid State Devices; Power Conditioning; Commercial Aircraft; Satellites

19980067785

Smart sensors and system health management tools for avionics and mechanical systems

Lewis, S. A., Honeywell Technology Center, USA; Edwards, T. G., Honeywell Technology Center, USA; 1997, pp. 8.5-1 to 8.5-7; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the development and application of smart sensors, Micro ElectroMechanical Systems (MEMS) devices, and system health management tools, developed at the Honeywell Technology Center, for avionics and mechanical systems. The Honeywell Technology Center has developed systems for integrated maintenance/diagnostics that range from low-level MEMS-based sensing and diagnostic components, through smart sensors and data concentrators that perform data acquisition, local environmental qualification, equipment monitoring and system health evaluation, and complete systems for health management and diagnostics/prognostics for industrial and DOD applications.

Author (AIAA)

Avionics; Smart Structures

19980067882

Near-field velocity measurements of confined square jet with primary and secondary tabs

Yu, Simon C. M., Nanyang Technological Univ., Singapore; Hou, Y. X., Nanyang Technological Univ., Singapore; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 288-290; In English; Copyright; Avail: Aeroplus Dispatch

The use of passive mixing devices to enhance the mixing of a jet with the surrounding environment has been investigated extensively in the past decade. Devices such as mixing tabs and lobed mixers have been shown to produce large-scale streamwise

vortices that cause a rapid spread and mixing of the jet downstream. The enhanced mixing characteristics can be attributed directly to the formation of these streamwise vortices. The mixing tabs are of particular interest due to their additional effectiveness in reducing the broadband acoustic emissions of the jet. A method to further enhance the tabs' effect, in which two secondary tabs were placed symmetrically on either side of the primary tab and directed into the ambient region, was proposed recently by Bohl and Foss (AIAA Paper 96-0545, Jan. 1996). The object of the investigation in this paper is to document further the jet flow with the secondary tabs at different angles with respect to the primary tabs. The experiments were conducted in a water tunnel using a laser-Doppler anemometer to provide detailed velocity measurements. It was shown that secondary tabs can effectively enhance the strength of streamwise vorticity generated by primary tabs. In a confined jet, a 50 percent increase in the peak vorticity can be found with the secondary tabs oriented at about 10 deg with respect to the horizontal plane in comparison with larger angles or no secondary tabs. All of the cases considered in this paper showed that the streamwise vorticity dissipated within six diameters downstream of the exit plane.
AIAA
Near Fields; Jet Mixing Flow; Flow Geometry; Tabs (Control Surfaces)

19980068016

Study on the mechanism of subharmonic instability of nonlinear rotor/seal systems

Ding, Qian, Tianjin Univ., China; Chen, Yushu, Tianjin Univ., China; Journal of Vibration Engineering; Dec. 1997; ISSN 1004-4523; Volume 10, no. 4, pp. 404-412; In Chinese; Copyright; Avail: Aeroplus Dispatch

The Muszynska model of seal fluid dynamical forces is used to investigate the mechanism of subharmonic instability in a single span rotor/seal system. The Hopf bifurcation of the system in the balanced case is studied, and it is shown that the system is led from its equilibrium position into a periodically whirling state after the threshold speed is exceeded. The bifurcated whirling motion under the influence of the rotating unbalanced force, or the problem of the periodically perturbed Hopf bifurcation, is analyzed in this paper. The vibration behavior in the case of 1/2 subharmonic resonance and in the neighborhood of the equilibrium point is given, which provides a new theoretical basis in recognizing and protecting the rotor from the subharmonic resonant failures of the turbine machinery.
Author (AIAA)
Nonlinear Systems; Rotors; Harmonic Oscillation; Systems Stability; Seals (Stoppers); Resonance; Rotary Stability

19980068018

Influence of initial condition on the unstable vibration of a rotor system

Zhu, Tianyun, Southeast Univ., China; Yang, Jiangang, Southeast Univ., China; Journal of Vibration Engineering; Dec. 1997; ISSN 1004-4523; Volume 10, no. 4, pp. 510-514; In Chinese; Copyright; Avail: Aeroplus Dispatch

The operation mode of a journal in the bearing is analyzed from the viewpoint of nonlinear vibration. It is pointed out that the choice of journal's initial state has an influence on the vibration response. If the initial state is chosen outside the unstable limit, even if the working speed is lower than the unstable speed, self-excited vibration may occur. This limit is defined as an unstable limit of the initial state. The area of the unstable limit is influenced by the difference between the working speed and unstable speed. The influence of perturbation on self-excited vibration of the rotor-bearing system is analyzed based on the these results. Some new conclusions are given.
Author (AIAA)
Boundary Conditions; Rotors; Rotary Stability; Journal Bearings; Self Excitation

19980068043

Modeling of anisotropic turbulence in rapid rotation

Schiestel, R., Peujot-Citroen, France; Elena, L., Peujot-Citroen, France; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 7, pp. 441-451; In English; Copyright; Avail: Aeroplus Dispatch

A new model is proposed for the two-point correlation spectrum tensor in which the directional properties of the turbulent field can be considered in terms of the specific structural anisotropy tensor. This model was originally devised to deal with the effect of rotation on turbulence, but more general closures can be derived from it for inhomogeneous turbulence. Applications are described for flows between rotating disks, to illustrate the model's capabilities.
Author (AIAA)
Turbulence Models; Rotating Fluids; Anisotropy; Closure Law; Rotor Aerodynamics; Stators; Homogeneous Turbulence

19980068222

Vaporization of binary fuel mixture droplets in a thermal wind tunnel

Daif, A., Perpignan, Univ., France; Bouaziz, M., Perpignan, Univ., France; Grisenti, M., Perpignan, Univ., France; Journal of Thermophysics and Heat Transfer; Mar. 1998; ISSN 0887-8722; Volume 12, no. 1, pp. 107-113; In English; Copyright; Avail: Aeroplus Dispatch

We study the vaporization, in forced convection, of two or three binary fuel mixture droplets. The droplets are situated one behind the other and are evaporated by forced convection in a thermal wind tunnel equipped with a video recording system. The image processing provides the radius regression of the droplets in accordance with the elapsed time, which is compared with results from a calculated model based on the concept of the gaseous film surrounding the droplets and the source of heat and mass transfer. During the period of suspension of the droplets, their vaporization begins in natural convection. From the opening of the obturator that allows the arrival of hot airflow, the forced convection sequence begins, as does the interaction between droplets. Average Nusselt and Sherwood numbers used for the calculation of gaseous film thicknesses surrounding droplets come from established correlations in natural and forced convection. In the case of interaction, these Nusselt and Sherwood numbers are corrected. The experiments and calculations that are undertaken for several mixtures of heptane and decane, and for several distances between the droplets, are in good agreement. Numerical results of the validated model are analyzed using a systematic parametric study.

Author (AIAA)

Binary Fluids; Vaporizing; Wind Tunnels

19980068305

Aeroelastic tailoring of blades - Prospects for reducing unsteady loads and enhancing performance

Leconte, Philippe, ONERA, France; Szechenyi, Edmond, ONERA, France; ONERA, TP no. 1997-31; 1997; In English
Report No.(s): ONERA, TP no. 1997-31; Copyright; Avail: Aeroplus Dispatch

Aeroelastic tailoring of wind turbine blades is a design procedure which adjusts the structural properties of blades so that their dynamic behavior answers particular specified requirements. The object of this paper is to explore the possibilities for using aeroelastic tailoring in reducing unsteady blade root bending moments and in enhancing power conversion capabilities. In order to arrive at realistic conclusions the study is carried out for an existing 300 kW wind turbine. The unsteady aerodynamic loads considered are exclusively 1 per rev due to wind shear and yaw. It is shown that a significant reduction in unsteady blade root bending moments can be obtained by optimizing the properties of the fundamental mode of vibration of the blade. The essential parameter is the position of the nodal line for this mode. This also strongly affects the aerodynamic damping of the blade, which is a very significant factor as increased damping will reduce loads due to transient and random excitation.

Author (AIAA)

Aeroelasticity; Turbine Blades; Wind Turbines; Aerodynamic Loads; Unsteady Aerodynamics; Performance Prediction

19980068675

Investigation on non-linear wall interference correction for model tests in transonic wind tunnel

Fan, Zhaolin, China Aerodynamics Research and Development Center, Mianyang, China; He, Zhong, China Aerodynamics Research and Development Center, Mianyang; Zhang, Yulun, China Aerodynamics Research and Development Center, Mianyang; Chen, Zuobin, China Aerodynamics Research and Development Center, Mianyang; Yin, Luping, China Aerodynamics Research and Development Center, Mianyang; 1997, pp. 90-97; In English; Copyright; Avail: Aeroplus Dispatch

This paper briefly describes a nonlinear 3D transonic wall interference correction method, developed at the High Speed Aerodynamics Institute of CARDC by combining wind tunnel tests and CFD. In this method, the flow field over the model is simulated by Euler and N-S equations; the measured pressure distributions near the transonic ventilated walls are used as the boundary conditions of tunnel flow field; and the differences between tunnel flow field and free flow field over the model are numerically solved and taken as wall effects. The effects of the wall interference on the structure of the transonic flow field over the model can be directly and conveniently analyzed. This method has been applied to transonic wall interference correction for several models in various test sections, and the results are satisfactory.

Author (AIAA)

Wind Tunnel Tests; Transonic Wind Tunnels; Aerodynamic Interference; Computational Fluid Dynamics; Wall Flow

19980068676

A new correction method for sidewall interference in 2-D wind tunnel testing

Cheng, Keming, Nanjing Univ. of Aeronautics and Astronautics, China; Heddergott, A., DLR, Inst. fuer Stroemungsmechanik, Germany; Stanewsky, E., DLR, Inst. fuer Stroemungsmechanik, Germany; 1997, pp. 98-102; In English; Copyright; Avail: Aeroplus Dispatch

A completely novel correction method for sidewall interference in 2D wind tunnel testing was developed. The new approach is of local type, correcting local flow parameters instead of adjusting incoming conditions as done in previous global-type corrections. The present method gives a more reasonable explanation of sidewall interference. It has the capacity to reveal primary sidewall boundary layer effects, including 3D distortion effects, 2D blockage effects, local lift effects, and wall suction influences. As an illustration of the method, some theoretical simulations were conducted. Preliminary theoretical results show that the new correction approach should be encouraged.

Author (AIAA)

Aerodynamic Interference; Wind Tunnel Tests; Two Dimensional Flow; Flow Measurement

19980068742

Brush electro-plating repairing technology for fighter aerocannon worn parts

Feng, Chunxiao, Air Force, First Aeronautical Inst., China; 1997, pp. 486-488; In English; Copyright; Avail: Aeroplus Dispatch

This paper deals with the process flow, the formulation of plating solutions, and the repair of fighter aerocannon worn parts. It proposes a method of repairing the worn parts using brush electro-plating.

Author (AIAA)

Electroplating; Fighter Aircraft; Aircraft Maintenance; Guns (Ordnance)

19980068744

Optimization of joints for rapid and on-site adhesive bond repairs to damaged aircraft skin

Jiao, Liang, Chinese Air Force, First Aeronautical College, China; Lu, Jiankun, Chinese Air Force, First Aeronautical College, China; 1997, pp. 494-497; In English; Copyright; Avail: Aeroplus Dispatch

Research was conducted on the optimization of adhesive bond joints used for rapid on-site and field-mending of holes in aircraft skin damaged in battle. A better mending scheme is presented and verified by experiments.

Author (AIAA)

Adhesive Bonding; Damage; Skin (Structural Member); Aircraft Maintenance; Structural Design

19980068745

Research on rapid field bond repair of battle damaged aircraft skin

Lu, Jiankun, Chinese Air Force, First Aeronautical College, China; Jiao, Liang, Chinese Air Force, First Aeronautical College, China; 1997, pp. 498-500; In English; Copyright; Avail: Aeroplus Dispatch

The procedure and properties of rapid adhesive bonding repair of aircraft aluminum skin are studied. The repair process is optimized. The studies show that rapid adhesive bonding repair can be used in wartime emergencies.

Author (AIAA)

Aircraft Maintenance; Skin (Structural Member); Damage; Combat; Adhesive Bonding

19980068749

Establishment and development of corrosion control system engineering in design of new type fighter

Mao, Lixing, Beijing Inst. of Aeronautical Materials, China; Li, Jingui, Beijing Inst. of Aeronautical Materials, China; Cao, Shuode, Beijing Inst. of Aeronautical Materials, China; Liu, Fengling, Beijing Inst. of Aeronautical Materials, China; 1997, pp. 517-522; In English; Copyright; Avail: Aeroplus Dispatch

Corrosion control system engineering technology and its application on a new type of fighter are discussed. The alloys making up the protective system are addressed along with the system's anticorrosion labyrinth design and the welding, plating, and assembly processes used in its production.

AIAA

Corrosion Prevention; Systems Engineering; Fighter Aircraft; Aircraft Design

19980068884

Real-time holographic analysis of the modal and dynamic characteristics of an advanced graphite-epoxy missile flight control structure

Fein, Howard, Polaris Research Group, USA; 1997, pp. 373-380; In English; Copyright; Avail: Aeroplus Dispatch

Holographic interferometry has offered a powerful tool to aid in the primary engineering and development of advanced graphite-epoxy fiber composite structures which are finding increased use in advanced aerodynamic platforms. Smart weapon and mis-

sile control structure applications must consider environments where extremes in vibration and mechanical stresses can affect both operation and structural stability. These are ideal requisites for analysis using advanced holographic methods in the initial design and subsequent test of such advanced components. Holographic techniques are non-destructive, real-time, and definitive in allowing the identification of vibrational modes, displacements, and motion geometries. Deriving such information without having to resort to in-flight data collection methods can be crucial to the determination of mechanical configurations and designs, as well as critical operational parameters.
Author (AIAA)
Missile Control; Real Time Operation; Holographic Interferometry; Flight Control; Graphite-Epoxy Composites; Aerodynamic Characteristics

19980069056

Design of controllers for MG3 compressor models with general characteristics using graph backstepping

Banaszuk, Andrzej, California, Univ., Davis, USA; Krener, Arthur J., California, Univ., Davis; 1997, pp. 977-981; In English
Contract(s)/Grant(s): F49620-95-1-0409; Copyright; Avail: Aeroplus Dispatch

We discuss the design of controllers for compressors with general characteristics using a graph backstepping procedure involving the construction of the throttle surface. We show that for a quite general compressor characteristic, every potential axisymmetric equilibrium on the decreasing part of the compressor characteristic, the peak of the characteristic, and every rotating stall equilibrium close to the peak can be globally stabilized by an appropriate choice of the throttle surface and the controller gains. We discuss controllers that stabilize a range of the desired equilibria and guarantee a soft bifurcation of the equilibria as a set-point parameter varies.
Author (AIAA)
Controllers; Control Systems Design; Compressors; Throttling; Rotating Stalls

19980069057

Compressor surge control using a close-coupled valve and backstepping

Gravdahl, Jan T., Norwegian Univ. of Science and Technology, Norway; Egeland, Olav, Norwegian Univ. of Science and Technology, Norway; 1997, pp. 982-986; In English; Copyright; Avail: Aeroplus Dispatch

We propose antisurge controllers for a close-coupled valve in a compression system. The valve modifies the characteristic of the compressor and allows for stable operation beyond the original surge line. The design tool used is backstepping and global uniform asymptotic stability is proven. Damping terms are included in the controllers, and in the presence of both mass flow and pressure disturbances, global uniform boundedness and convergence to a set is ensured. Under the assumption of decaying disturbances, the controller ensures convergence to the origin.
Author (AIAA)
Compressors; Surges; Controllers; Valves; Compressor Efficiency

19980069058

Combined air injection control of rotating stall and bleed valve control of surge

Behnken, Robert L., California Inst. of Technology, Pasadena, USA; Murray, Richard M., California Inst. of Technology, Pasadena; 1997, pp. 987-992; In English
Contract(s)/Grant(s): F49620-95-1-0409; Copyright; Avail: Aeroplus Dispatch

Previous work at Caltech has developed a controller for rotating stall in axial flow compressors using pulsed air injection. In this work, a theory is developed for the combination of this air injection controller with a bleed valve controller for the system's surge dynamics. The controller analysis is based on the surge dynamics acting on a slow time scale relative to the rotating stall dynamics. Experiments demonstrating this controller design on the Caltech rig are also presented.
Author (AIAA)
Rotating Stalls; Surges; Valves; Controllers; Turbocompressors

19980069278

Acceleration based smart structure (MEMS) control design for aerospace applications

Tseng, Yuan-Wei, Ohio State Univ., Columbus, USA; Yedavalli, R. K., Ohio State Univ., Columbus; Khot, N. S., USAF, USA; Veley, D., USAF, USA; 1997, pp. 2662-2666; In English; Copyright; Avail: Aeroplus Dispatch

In this paper, a design approach for controlling a composite plate structure subject to aeroelastic loading using piezoelectric actuators and sensors is presented. The nature of the sensing variables is exploited and accommodated in the control design algorithm. The controller is a state estimate based feedback using various measurements related to motion variables such as accelera-

tions, velocities, and displacements. Controller designs are based on equivalent First Order State-Space baseline design gains that use existing algorithms. The proposed method provides different norms for estimator and controller gains, thereby allowing more flexibility in gain magnitudes and selection of sensors.
Author (AIAA)
Smart Structures; Control Systems Design; Aerospace Engineering; Aeroelasticity; Plates (Structural Members)

19980069403

Surge control and test functions for axial flow compressors

Kang, Wei, U.S. Naval Postgraduate School, USA; Gu, Guoxiang, Louisiana State Univ., Baton Rouge; Sparks, Andy, USAF, Wright Lab., USA; Banda, Siva, USAF, Wright Lab., USA; 1997, pp. 3721-3725; In English; Copyright; Avail: Aeroplus Dispatch

The focus of this paper is bifurcation control for axial flow engine compressors. We introduce test functions whose zeros are critical to Hopf bifurcation for the closed-loop system where nonlinear feedback control laws are employed. A test function is also developed to determine stability of the periodic solutions born at Hopf bifurcation. The analysis based on these test functions leads to a new method of feedback design for control of both stationary and Hopf bifurcation in axial flow compressors. Using the techniques proposed in this paper, feedback controllers can be designed to meet several bifurcation control requirements, including elimination of the behavior of surge, coupled with rotating stall. The three-state Moore-Greitzer model is introduced and feedback control laws that soften the transcritical bifurcation are presented. A test function is developed for the existence of Hopf bifurcation in the closed-loop compression system. A particular test function is developed to determine stability of the family of periodic solutions eminated from the Hopf bifurcation point. The simulation results are displayed to show stability of the closed-loop system, as well as feedback stabilization in presence of both rotating stall and surge.
Author (AIAA)
Turbocompressors; Branching (Mathematics); Surges; Control Systems Design; Feedback Control

19980069408

Study of the contact heat transfer coefficient at high temperature and heavy pressure

Lair, P., FORTECH-ARDEM, Pamiers; ONERA, Centre d’Etudes et de Recherches de Toulouse, France; Dumoulin, J., ONERA, Centre d’Etudes et de Recherches de Toulouse, France; Millan, P., ONERA, Centre d’Etudes et de Recherches de Toulouse, France; 1997, pp. 3786, 3787; In English; Copyright; Avail: Aeroplus Dispatch

Boundary conditions during the hot forming process of high quality steel are not well controlled. Thus, the thermal contact conductance is required for their numerical simulation. One way to obtain these data is to measure it. This paper deals with the signal processing that will be applied to the data from the experiments. This signal processing is based on an inverse heat conduction method.
Author (AIAA)
Heat Transfer; Aircraft Industry; Hot Working; High Pressure; Heat Resistant Alloys; Thermomechanical Treatment

19980070149

The principle of local load equivalence in estimating fatigue life ***Printsip lokal’noj ehkvivalentnosti nagruzok pri otsenke ustalostnoj dolgovechnosti***

Adrov, V. M., Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 10-13; In Russian; Copyright; Avail: Aeroplus Dispatch

An approach is proposed whereby the Smith parameter is used as a criterion of the local equivalence of loading cycles in estimating the fatigue life. by considering the local stress-strain state in the stress raiser region and by using the proposed criterion, loading cycle equivalence conditions are obtained for nominal stresses in the form of expressions similar to the Oding formula. The dependences of the parameters of these expressions on the deformation properties of the material are determined in explicit form.
AIAA
Aircraft Structures; Cyclic Loads; Stress Intensity Factors; Fatigue Life; Stress-Strain Relationships

19980070156

A new scheme for a combination power plant ***Novaya skhema kombinirovannoj ehnergeticheskoj ustanovki***

Gritsenko, E. A., AO SNTK im. N.D. Kuznetsova, Russia; Reznik, V. E., AO SNTK im. N.D. Kuznetsova, Russia; Danil’chenko, V. P., AO SNTK im. N.D. Kuznetsova, Russia; Gorelov, G. M., AO SNTK im. N.D. Kuznetsova, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 61-64; In Russian; Copyright; Avail: Aeroplus Dispatch

Results of a study of a novel combination power plant characterized by improved fuel efficiency and high power output are reported. The power plant employs a converted retired aircraft engine as the main component which is combined with a compressor and a heat exchanger for heat utilization. The proposed plants can successfully use converted aircraft engines of different generations and are particularly efficient when combined with a steam/gas plant.
AIAA
Gas Turbine Engines; Power Efficiency; Heat Transfer; Waste Energy Utilization; Gas Mixtures

19980070163

Calculation of trapezoidal plates (membranes, sections) by shape factor interpolation ***Raschet trapetsievidnykh plastinok /membran, sechenij/ metodom interpolyatsii po koehffitsientu formy***

Korobko, A. V., OGSKhA, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 103-107; In Russian; Copyright; Avail: Aeroplus Dispatch

Various techniques of geometrical transformations are examined which make it possible to obtain a large number of trapeziums from two reference shapes (e.g., a rectangle and a triangle, a rectangle and a rhombus, and other combinations). This makes it possible to apply the known solutions based on shape factor interpolation. The shape interpolation method is based on the modeling of the integral physicomechanical parameters of structural mechanics problems by using an integral geometrical characteristics of a region (shape factor). Examples of problems in structural mechanics that can be solved by this method include transverse bending and natural vibrations of membranes; transverse bending, stability, natural vibrations, and equilibrium limit of plates; and torsion of prismatic beams.
AIAA
Plate Theory; Trapezoids; Interpolation; Form Factors; Trigonometric Functions; Aircraft Structures

19980070236

International Non-Ferrous Processing and Technology Conference, 1st, Saint Louis, MO, Mar. 10-12, 1997, Proceedings

1997; In English; ISBN 0-87170-592-3; Copyright; Avail: Aeroplus Dispatch

This conference volume on non-ferrous materials processing and technology includes papers presented on the effect of section size, quenchant concentration, and agitation on the physical properties of Type I polymer-quenched aluminum alloys, the rapid mechanical alloying of metal powders, enhancing fatigue life and damage tolerance of holes in non-ferrous alloys, the teardown inspection of full-scale airframe fatigue test articles, the cast preform process, the commercial development of D357 alloy investment cast aircraft door substructures, finite element modeling of the machining of non-ferrous metals, aspects of microstructure and working history of high-strength aluminum forged end-product performance, the thermomechanical tube spinning of 7075 aluminum alloys, processing parameters for superplastic forming (SPF) and diffusion, the identification and control of key manufacturing process variables on SPF of complex titanium structures, an investigation on SPF/DB processing of zincified alloy LY11, and the development and capability of the SPForm finite element modeling program. Additional papers are presented on a review of alternatives to water quenching of aluminum alloys, aerodynamic heat treat furnaces, the application of electrochemical techniques for machining titanium aluminide-based alloys, the application of classical DC electrochemical technology at McDonnell Douglas Aircraft, the effect of the cooling rate on heat treatment response in an aluminum alloy, and the past, present, and future of low-pressure die casting. Other papers are also presented on residual stresses in a 7050 aluminum alloy restruck forged block, the properties of a thin structure machined from 7050 aluminum plate, and the development of new Al alloys for distortion-free machined aluminum aircraft components. The remaining papers fall under the topics of high-speed machining, heat treatment and quenching, aluminum product forms, casting technology, fatigue resistance and improvement, powder metallurgy and HIP, titanium, superalloys, and electrochemical processes.
AIAA
Conferences; Nonferrous Metals; Aluminum Alloys; Aircraft Structures; Mechanical Properties

19980070240

Teardown inspection of full scale airframe fatigue test articles

Coulter, R. W., McDonnell Douglas Aerospace, USA; MacKenzie, D. S., McDonnell Douglas Aerospace, USA; 1997, pp. 45-51; In English; Copyright; Avail: Aeroplus Dispatch

This report presents the processes which were developed to identify and track test parts, perform inspections, and failure analysis and record test data obtained during consecutive teardown inspections on multiple full-scale airframe fatigue test articles. After having been subjected to the equivalent of two lifetimes of simulated flight spectrum fatigue testing, selected structural areas from two full-scale airframe fatigue test articles consisting of three model configurations were completely disassembled and inspected for cracks. This data would then be analyzed to update aircraft structural maintenance plans. To detect any damage which

resulted from fatigue testing, various NDT techniques were used to inspect the structural parts. For those parts that contained visible cracks (not attributed to disassembly) or which had NDT flaw indications representative of fatigue cracks, the suspect areas were mechanically removed from the structure. Subsequent failure analysis was performed to determine and document failure mode, fatigue origin, fatigue zone dimensions, and the presence of any possible pre-existing anomalies that might have contributed to crack initiation. Selected fatigue cracks were analyzed for fracture characteristics to aid in the determination of crack initiation and crack growth. It was imperative that all five model type/component configurations be analyzed consecutively to meet time constraints imposed due to early model aircraft that were approaching critical flight-hour inspection sequences. It was thereby necessary for all teardown and inspection techniques, as well as identification and recording processes, to be greatly improved for accuracy and efficiency. For these test articles a total of 8289 parts were inspected by various methods. Of the 576 cracks in 193 parts which were identified as having been initiated by fatigue, 20 had fracture topographies which were optically analyzed for crack growth characteristics.
Author (AIAA)
Airframes; Full Scale Tests; Failure Analysis; Fatigue Tests; Cracking (Fracturing); Nondestructive Tests

19980070251

Aerodynamic heat treat furnaces - Myth or reality

Sverdlin, A. V., Bradley Univ., USA; Ness, A., Bradley Univ., USA; 1997, pp. 179-184; In English; Copyright; Avail: Aeroplus Dispatch

Aerodynamic heat treat furnaces (AHTFs), in which air or gas is heated to 600-700 C without electrical or other special heaters, have been developed and placed in operation in a number of plants for heat treating aluminum, magnesium, and titanium alloys, and also steels. The AHTF chamber furnace is thermally insulated without the use of fire bricks. It has a centrifugal fan with vanes having a special contour. The fan, operating in a closed system, converts into heat almost all the energy used to turn it; the heat is transferred to the parts by convection. In most machine-building plants aluminum alloys are heat treated in ERF furnaces (electric resistance furnaces with forced air circulation) or in salt baths. This research deals with an investigation of the heating conditions for various semifinished products of aluminum alloys in the AHTF-3 in comparison with the ERF-2 furnace and a potassium nitrate bath of approximately the same working volume.
Author (AIAA)
Aluminum Alloys; Furnaces; Aerodynamic Heating; Heat Treatment; High Temperature Gases; Titanium Alloys

19980070257

Properties of thin structure machined from 7050 aluminum plate

Nash, R. A., Boeing Commercial Airplane Group, USA; McElroy, B. J., Boeing Commercial Airplane Group, USA; Miller, B. A., Jr., Boeing Commercial Airplane Group, USA; 1997, pp. 239-248; In English; Copyright; Avail: Aeroplus Dispatch

The development of advanced machining technology has opened a conduit to a new realm of design options involving thin machined monolithic structures. Simultaneously, research and development activities by the aluminum plate manufacturers have increased gauge availability to 216 mm and significantly improved the fatigue and fracture toughness performance of 7050-T7451 plate. These advancements in material quality and machining technology may allow for the replacement of conventional built-up aircraft structures with machined monolithic structures, provided traditional fail-safety requirements can be met. The use of monolithic structures allows for reductions in part counts and assembly labor, potentially providing manufacturing producibility improvements and economic savings. Although this is a very attractive incentive, many serious concerns arise when a thin structure is machined from a thick product such as plate. Assumptions regarding the applicability of conventional design properties and of the effect of standard part surface treatment processes such as anodizing or shot peening on design properties may need to be reconsidered. This research explores these thin section issues, including the influence of gage and processing on the mechanical properties, fatigue, and fracture toughness of thin sections. These studies indicate that properties of the final product can be influenced by section thickness and part processing.
Author (AIAA)
Aluminum Alloys; Thin Plates; Machining; Fatigue Life; Fracture Strength; Aircraft Structures

19980070258

Development of new Al alloys for distortion free machined aluminium aircraft components

Heymes, F., Pechiney, France; Commet, B., Pechiney, France; Du Bost, B., Pechiney, France; Lassince, P., Pechiney Rhenalu, France; Lequeu, P., Pechiney Rhenalu, France; Raynaud, G.-M., Pechiney Rhenalu, France; 1997, pp. 249-255; In English; Copyright; Avail: Aeroplus Dispatch

Final manufacturing steps such as shape correction play a significant role in the manufacturing time cycle and costs of machined aluminum aircraft parts. Partial or complete removal of machining distortions is therefore of great interest for aircraft manufacturers. The objective of this paper is to show that only a complete understanding of the relationships between processing steps of both the aluminum producer and of the aircraft manufacturer can lead to a significant decrease of distortions. In order to reach such an optimization the Pechiney Rhenalu and Pechiney Voreppe research centers in France have developed computer programs to predict the influence of the manufacturing parameters on the through-thickness distribution of internal stresses of rolled plates. Such modeling requires additional data which are often difficult to measure and which involve specific laboratory experiments. In order to control the plate residual stress level, this metallurgical development must be associated with suitable and controlled technological workshop apparatus. These extensive studies have led Pechiney to the development of new alloys and products which are outlined. For example: (1) new very low internal stress AA2024A alloy plates exhibiting excellent fracture toughness properties, (2) ultrathick 7010 and 7050 plates exhibiting equivalent mechanical properties to forgings but with a very significant decrease in residual stress levels, (3) new AA7040 thick plates aiming for the best compromise between internal stresses, fracture toughness, tensile properties, and corrosion behavior.
Author (AIAA)
Aluminum Alloys; Aircraft Parts; Machining; Surface Distortion; Residual Stress; Process Control (Industry)

19980070259
Production of light gauge extreme wide clad and bare aircraft sheet using a horizontal heat treatment furnace with a spray quench system
Mueller, O., Hoogovens Aluminum Rolled Products GmbH, Germany; Haszler, A., Hoogovens Aluminum Rolled Products GmbH, Germany; 1997, pp. 301-304; In English; Copyright; Avail: Aeroplus Dispatch

The equipment and a production practice for processing light-gauge extremely wide clad and bare aircraft sheets have been developed. Because of the extreme width, it was necessary to use the ’single sheet production route’ instead of the ’coil production route’. The major problems of the ’single sheet production route’ are related to fabrication-influenced and metallurgically influenced critical factors.
AIAA
Aircraft Parts; Metal Sheets; Heat Treatment; Product Development; Quenching (Cooling); Spraying

19980070263
Exploiting forgings in the successful fabrication of large, low cost, high performance monolithic airframe structures - An appraisal of available design and process technologies and performance capabilities of Al and Ti forgings
Kuhlman, G. W., Alcoa Forged Products, USA; Lyon, S. C., Alcoa Forged Products, USA; Richards, W. T., Alcoa Forged Products, USA; Bucci, R. J., Alcoa Labs., USA; 1997, pp. 335-346; In English; Copyright; Avail: Aeroplus Dispatch

Major reductions in airframe component manufacturing costs and lead and flow times have become paramount objectives for both commercial and military OEM airframe manufacturers. These efforts are expected to achieve at least comparable cost and acquisition time reductions for the final aircraft customer: the airline and its passengers. Cost and lead/flow time reductions at all levels of the airframe component supply stream are thus the leading objectives driving Management, Design, Engineering, and R&D efforts throughout the manufacturing stream, from raw material producer to intermediate product form fabricator (e.g. forger, extruder, caster, roller) to machining source and into the OEM’s final assembly. Part count reduction through large high-performance monolithic structure is a key enabling technology supporting the drive to lower costs and significant contraction of the overall time required for airframe design and manufacturing. Large high-quality high-performance aluminum and titanium alloy open and particularly closed-die forgings have traditionally been and remain a preferred raw material product form with superior properties. Forgings are also a key enabling product form to improve cost and time efficiency for high-performance monolithic structural components. Presented is a state-of-the-art appraisal in critical forging technologies: (1) concurrent engineering, (2) forging design, (3) forging engineering and process modeling, (4) forging processing to enhance use, (5) forging thermomechanical processing for property optimization, and (6) forging product performance. Each of these technologies facilitate capture of a variety of forging products in cost-efficient large monolithic structures and will be heavily exploited as the demand for monolithic structures grows in the foreseeable future.
Author (AIAA)
Airframes; Forging; Aircraft Production Costs; Cost Reduction; Aircraft Design

19980070264
’W’ condition process of the sheet metal center’s hydropress forming cell
Leon, L. R., Boeing Commercial Airplane Group, USA; 1997, pp. 383-387; In English; Copyright; Avail: Aeroplus Dispatch

This report is presented to show how the Boeing Commercial Airplane Group, Seattle, WA, is using the 'W' condition process as the main sheet-metal forming process. Summarized are the theory differences between the 'O' and 'W' condition processes. Major improvements have occurred to the hydropress tooling fabrication process, quality assurance, the raw material, and the sheet-metal process.
Author (AIAA)
Metal Sheets; Product Development; Pressing (Forming); Hydroforming; Aircraft Structures; Presses

19980070449
Image understanding algorithms for remote visual inspection of aircraft surfaces
Gunatilake, Priyan, Carnegie Mellon Univ., USA; Siegel, M. W., Carnegie Mellon Univ., USA; Jordan, A. J., Carnegie Mellon Univ., USA; Podnar, G., Carnegie Mellon Univ., USA; 1997, pp. 2-13; In English; Copyright; Avail: Aeroplus Dispatch

Visual inspection is, by far, the most widely used method in aircraft surface inspection. We are currently developing a prototype remote visual inspection system, designed to facilitate testing the hypothesized feasibility and advantages of remote visual inspection of aircraft surfaces. In this paper, we describe several experiments with image understanding algorithms that were developed to aid remote visual inspection, in enhancing and recognizing surface cracks and corrosion from the live imagery of an aircraft surface. Also described in this paper are the supporting mobile robot platform that delivers the live imagery, and the inspection console through which the inspector accesses the imagery for remote inspection. We discuss preliminary results of the image understanding algorithms and speculate on their future use in aircraft surface inspection.
Author (AIAA)
Algorithms; Image Analysis; Remote Sensing; Inspection; Aircraft Maintenance

19980070617
Advanced detectors, optics, and waveform digitizers for aircraft DIAL water vapor measurements
De Young, R. J., NASA Langley Research Center, USA; Halama, G. E., NASA Langley Research Center, USA; Luck, W. S., NASA Langley Research Center, USA; Ellis, K. S., NASA Langley Research Center, USA; Sandford, S. P., NASA Langley Research Center, USA; Browell, E. V., NASA Langley Research Center, USA; Refaat, T., Old Dominion Univ., USA; 1997, pp. 103-115; In English; Copyright; Avail: Aeroplus Dispatch

NASA/Langley has an active water vapor DIAL program taking measurements from both C-130 and ER-2 aircraft. A research effort has started to increase the SNR in the DIAL receiver by (1) evaluating new very low noise avalanche photo diodes (APDs), (2) designing an optics system that will focus the return light signal to the APD efficiently, and (3) constructing a 10-MHz waveform digitizer board that will be small enough to be placed at the APD and telescope. With these advances we anticipate improving the SNR by a factor of ten over the current receiver system.
Author (AIAA)
Waveforms; Analog to Digital Converters; Differential Absorption Lidar; Water Vapor; Photodiodes; C-130 Aircraft

19980070658
Handbook: Manufacturing advanced composite components for airframes
Price, Terry L., Cerritos College, USA; Dalley, George, Cerritos College, USA; McCullough, Patrick C., Cerritos College, USA; Choquette, Lee, Cerritos College, USA; 1997; In English
Contract(s)/Grant(s): FAA-95-G-045
Report No.(s): DOT/FAA/AR-96/75; Copyright; Avail: Aeroplus Dispatch

The handbook contains basic information on the principles, fundamentals, and technical procedures related to the manufacture, inspection, and repair of fiber composites used in civil airframes. In particular, attention is given to fiber materials and fiber forms, matrix materials, core materials and types of cores, tooling, manufacturing processes and methodologies, processing and machining, quality assurance and types of tests, and assembly. Finally, the safety, health, and environmental aspects of composite airframe component manufacturing are discussed.
AIAA
Handbooks; Aircraft Production; Airframes; Aircraft Parts; Aircraft Construction Materials; Composite Structures

19980071120
Infrasonic observations of bolides on October 4, 1996
ReVelle, Douglas O., Los Alamos National Lab., USA; Whitaker, Rodney W., Los Alamos National Lab., USA; Armstrong, William T., Los Alamos National Lab., USA; 1997, pp. 156-167; In English; Copyright; Avail: Aeroplus Dispatch

During the evening of October 3, 1996, at least six bright fireballs were observed over the western U.S. with reports from California to Louisiana. The event over California produced tremendous sonic boom reports in the Los Angeles area. Both the seismic and infrasound recordings indicated that an explosion occurred in the atmosphere, having its epicenter near Little Lake, CA, for possible sources heights from 40-60 km. The signal characteristics, analyzed from 0.1 to 5.0 Hz, includes a total duration of 5 to 20 min for a source directed toward 230-240 deg from true North. The signal trace velocities ranged from 300-360 m/s with a signal velocity of 0.30 +/- 0.03 km/s, implying a Stratospheric (S Type) ducted path (with a reflection altitude of from 40-60 km). The dominant signal frequency is from 0.20 to 0.80 Hz, with a peak near 0.2 to 0.25 Hz. These highly correlated signals had a maximum amplitude of 1.0 microbars (0.1 Pa) at PDL and 4.0 microbars (0.4 Pa) at NTS. Our analysis indicates that the bolide had a probable, maximum source energy in the range 150-390 tons (TNT equivalent).
Author (AIAA)
Bolides; Infrasonic Frequencies; Fireballs; Sonic Booms; Seismology

19980071243

Joining and repair of aircraft composite structures

Baker, Alan, DSTO, Aeronautical and Maritime Research Lab., Australia; Composites engineering handbook; 1997, pp. 671-776; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of current practices in the points connecting structural elements composed of advanced fiber-composite laminates, especially the frequently-used graphite/epoxy, either to metals or to other composites. The joint types discussed encompass single-lap, double-lap, step-lap, and scarf joints. Attention is given to elastic and elastoplastic modeling of the adhesive, thermal expansion mismatches, the types of structural adhesives and their mechanical properties, and the fatigue properties of joints. Design criteria and repair techniques for all types of joints are discussed.
AIAA
Aircraft Structures; Composite Structures; Aircraft Maintenance; Graphite-Epoxy Composites; Lap Joints; Fatigue Life

19980071250

Nondestructive tests

Mallick, P. K., Michigan, Univ., Dearborn, USA; Composites engineering handbook; 1997, pp. 1147-1181; In English; Copyright; Avail: Aeroplus Dispatch

A survey is presented of NDT methods for determining the quality of polymer-matrix composites in various industries. The aircraft industry employs radiographic and ultrasonic methods for detecting manufacturing defects in composite components. Many of the NDT methods discussed, which include angular spectrum scanning, deep reflection coefficient imaging, and fluorescent penetrant methods, are also applicable to metal matrix and ceramic matrix composites.
AIAA
Polymer Matrix Composites; Nondestructive Tests; Aircraft Industry; Ultrasonic Tests; Radiography; Fault Detection

19980071361

Experimental investigation of the flow structure near a single wraparound fin

Tilmann, C. P., USAF, Wright Lab., USA; Huffman, R. E., Jr., USAF, Wright Lab., USA; Buter, T. A., USAF, Inst. of Technology, USA; Bowersox, R. D. W., Alabama, Univ., Tuscaloosa; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 729-736; In English; Copyright; Avail: Aeroplus Dispatch

The flow structure near a single wraparound fin on a wall-mounted semicylindrical model was experimentally investigated at Mach 2.8 (Re/l = 18 x 10 exp 6/m). Detailed mean flow and turbulence measurements were obtained using conventional pressure probes and cross-wire hot-film anemometry at a series of stations near the fin. Large flow-field asymmetries were observed in both mean flow and turbulence measurements aft of the shock/boundary-layer interaction. Measured turbulence intensities in the fuselage boundary layer were far greater on the concave side of the fin than on the convex side. On the convex side of the fin, the turbulence intensity levels were 30 percent lower than the preinteraction values, and on the concave side a 50 percent increase was observed. Similarly, the Reynolds shear stress levels aft of the fin bow shock decreased on the convex side of the fin while increasing dramatically on the concave side. These results are consistent with the stabilizing and destabilizing effects of pressure gradient distortion on supersonic boundary layers.
Author (AIAA)
Flow Measurement; Flow Distribution; Fins; Turbulent Flow; Flow Geometry

19980071384

Reliability growth analysis of a type of turbojet engine

Zhou, Yuanquan, Beijing Inst. of Structure and Environment, China; Zhou, Baili, Beijing Electro-Mechanical Engineering Inst., China; Wang, Jiaming, Beijing Electro-Mechanical Engineering Inst., China; Journal of Propulsion Technology; Oct. 1997; ISSN 1001-4055; Volume 18, no. 5, pp. 17-21; In Chinese; Copyright; Avail: Aeroplus Dispatch

Nonsynchronous truncated failure data for a type of turbojet engine are obtained from several engine tests with zero failure. The tendency check, goodness of fit check, maximum likelihood estimates (MLEs) of the parameters, and MTBF for the AMSAA (Army Material Systems Analysis Activity) model are presented. Analysis indicates that those data have significant plus growth tendency and can be fitted by the AMSAA model, and that the MLEs of parameters and MTBF with consideration of zero failure are more convincing.

Author (AIAA)

Turbojet Engines; Mtbf; Reliability Analysis; Fault Detection; Engine Failure; Engine Tests

19980071422

Britain's aerospace industry

Nouvelle Revue d'Aeronautique et d'Astronautique; Feb. 1997; ISSN 1247-5793, no. 1, pp. 80-83; In English; Copyright; Avail: Aeroplus Dispatch

Britain's aerospace industry is, with France, jointly the second largest in the Western world, after the U.S., and exports around two-thirds of its output. It is the only one apart from the U.S. having total aerospace capabilities, as well as great depth in technical and management expertise. Activities of Britain's aerospace industry cover designing and constructing airframes, aeroengines, avionics, guided weapons, and space satellites, together with a full range of components, systems, subsystems, and associated services. Firms undertake prime contractor responsibilities for major projects and act as a total procurement agency, for instance, for a complete defense infrastructure with equipment and support.

Author (AIAA)

Aerospace Industry; Uk Space Program; Aircraft Engines; Avionics; Defense Program

19980071613

Two-dimensional coupled conduction and forced convection of a rectangular fin in a confined space

Eriksson, Daniel, Lund Inst. of Technology, Sweden; Sunden, Bengt, Lund Inst. of Technology, Sweden; 1997, pp. 3-14; In English; Copyright; Avail: Aeroplus Dispatch

Extended surfaces like fins are applied to enhance the heat transfer between a fluid and a solid structure. This paper concerns a numerical investigation of the 2D heat conduction in a rectangular fin in a confined space cooled or heated by turbulent forced convection. The governing equations for the flow and thermal fields are solved numerically in a coupled fashion. The turbulent motion is described by a low-Reynolds number k-epsilon model. A finite volume technique and a non-staggered grid arrangement is applied, and the pressure-velocity coupling is handled by the SIMPLEC algorithm. Comparisons with experimental data are made regarding the temperature distribution. Numerical results of the Nusselt number and fin efficiency are presented.

Author (AIAA)

Forced Convection; Two Dimensional Flow; Fins; Conductive Heat Transfer; Turbulent Heat Transfer; Computational Grids

19980071947

A numerical study of the coupled vibrations of a detuned turbomachine compressor rotor ***Chislennoe issledovanie vzaimosvyazannykh kolebanij rasstroennogo rabochego kolesa kompressora turbomashiny***

Zin'kovskij, A. P., NANU, Inst. Problem Prochnosti, Ukraine; Problemy Prochnosti; 1997; ISSN 0556-171X, no. 2, pp. 67-78; In Russian; Copyright; Avail: Aeroplus Dispatch

A numerical experiment was carried out to investigate the possible causes for the failure of a rotor with dovetail blade roots. The theory of the coupled vibrations of mechanical systems was used to determine the origin of the increased vibrational load. Results of a numerical analysis of the effect of the natural vibration spectra of the rotor and blade frequency detuning on the generation of resonance vibrations are reported.

AIAA

Gas Turbine Engines; Compressor Rotors; Structural Vibration; Structural Failure

19980072219

Optical condensation measurement in gas turbine engine inlets

Potter, Jason, Cranfield Univ., UK; Tatam, Ralph P., Cranfield Univ., UK; 1997, pp. 422-433; In English

Contract(s)/Grant(s): EPSRC-GR/K/37116; Copyright; Avail: Aeroplus Dispatch

A nonintrusive optical system for the measurement of air inlet condensation in gas turbine engines is presented. The system uses a technique in which a linear relationship between the Liquid Water Content (LWC) and the optical extinction coefficient exists. The extinction coefficient was determined by measuring the extinction of a 10.6 micron CO2 laser beam due to Mie scattering from water droplets and the LWC calculated from the linear relationship. Results of the extinction coefficient determined with the system used in a single transmission path mode on a condensing flow occurring in the inlet of a subsonic suction tunnel are presented together with the temperature rise of the ambient air calculated from the extinction coefficient. A rise of 8.65 K was obtained at 0.65 Mach, for an ambient temperature of 20 C and relative humidity 49 percent, which is consistent with previous nonoptical measurements.

Author (AIAA)

Gas Turbine Engines; Optical Measurement; Condensation; Optical Measuring Instruments

19980072582

Experimental analysis of the vibration of a foldable wing

Ren, Xingmin, Northwestern Polytechnical Univ., China; Yuan, Zhenyu, Northwestern Polytechnical Univ., China; Cui, Xining, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 536-541; In Chinese; Copyright; Avail: Aeroplus Dispatch

We use experimental displacement modality to replace the usually used experimental strain modality to calculate the stress response of wing type structures. The method proposed by us not only enhances the sensitivity but also enlarges the frequency measurement range of the measured vibration data. So the precision of the calculated stress response is improved as confirmed by our results. Using the above method we made detailed analysis of the vibration stress response of a foldable wing under transient shock load. Our theoretical and experimental research includes natural characteristics recognition, shock response calculation, and shock stress analysis for the foldable wing in 0, 30, 60, 90 degree positions. Experimental analysis was made in Northwesten Polytechnical University for a certain type of foldable wing. We obtained its experimental displacement modality, and then we worked out its shock stress response analysis.

Author (AIAA)

Folding Structures; Wing Oscillations; Structural Vibration

19980072600

Unsteady blade force in an axial compressor. I - Physical phenomena, experimental facility and calculations

Wo, Andrew M., National Taiwan Univ., Taipei, Taiwan, Province of China; Hsu, Shu-Tzung, National Taiwan Univ., Taipei; Chinese Society of Mechanical Engineers, Journal; Oct. 1997; ISSN 0257-9731; Volume 18, no. 5, pp. 427-436; In English; Copyright; Avail: Aeroplus Dispatch

Part I of this two-part paper discusses physical phenomena which lead to unsteady loading on an axial compressor blade, and the experimental facility and numerical methods employed to study the unsteady flow physics. The primary sources of unsteadiness are due to vortical and potential effects. The vortical contribution considered is due to upstream blade wakes convecting downstream and impinging upon the succeeding blade row, which is the dominant physical mechanism for unsteady blade force. The potential contribution arises from pressure disturbance due to relative motion between rotating and stationary blade rows. A newly built large-scale axial compressor research facility is described in detail. Navier-Stokes and panel codes are also used to complement the experimental effort. Methods used to decompose the disturbance and blade force into vortical and potential contributions are described and justified.

Author (AIAA)

Turbocompressors; Compressor Blades; Unsteady Flow; Force Distribution

19980072601

Unsteady blade force in an axial compressor. II - Results from upstream and downstream disturbances

Wo, Andrew M., National Taiwan Univ., Taipei, Taiwan, Province of China; Hsu, Shu-Tzung, National Taiwan Univ., Taipei; Chinese Society of Mechanical Engineers, Journal; Oct. 1997; ISSN 0257-9731; Volume 18, no. 5, pp. 437-443; In English; Copyright; Avail: Aeroplus Dispatch

The Part II of this two-part paper applies techniques and methods described in Part I to study the gust response on the stator of both rotor/stator and stator/rotor axial compressors, thus addressing the effect of disturbances from both upstream and downstream. Experiments were conducted in a large-scale, low-speed compressor rig, with two axial gap cases, 10 and 30 percent chord, and at two time-mean loadings. Both Navier-Stokes and panel codes were used to decompose the unsteady force into vortical and potential contributions. Results show that the vortical contributed response from upstream and the potential contribution from

downstream are both comparable in magnitude, with the upstream potential negligible. The effect of both upstream potential and vortical contributions on the stator response are essentially in-phase with the respective disturbance. That is, the time of occurrence of the maximum of unsteady force essentially coincides with that of the disturbance. The vortical contribution maximizes near the instant when the rotor wake impinges at the stator leading edge. The potential contributed response from downstream minimizes just prior to the downstream rotor sweeps past the stator trailing edge. These two contributions can be used beneficially to obtain minimum unsteady force on a turbomachinery blade.
Author (AIAA)
Turbocompressors; Unsteady Flow; Force Distribution; Gust Loads; Stators; Rotors; Turbine Blades

19980072647

Initial failure of mechanically fastened joints with offset loading

Falzon, B. G., Imperial College of Science, Technology and Medicine, UK; Davies, G. A. O., Imperial College of Science, Technology and Medicine, UK; Advanced Composites Letters; 1997; ISSN 0963-6935; Volume 6,, no. 4, pp. 91-94; In English; Copyright; Avail: Aeroplus Dispatch

The initial failure of a bolted composite joint is investigated. The results of an experimental program using two simple beams bolted together with offset loading are presented. These test specimens were used to simulate a typical skin-spar attachment in a composite wing undergoing hydraulic shock. Initial failure is found to be due to a prying force induced at the outer sections of the joint leading to transverse shear failure.
Author (AIAA)
Bolted Joints; Failure Analysis; Beams (Supports); Wings; Failure Modes; Hydraulic Shock

19980072653

A study on the stability and Hopf bifurcation of a nonlinear rotor-seal system

Chen, Yushu, Tianjin Univ., China; Ding, Qian, Tianjin Univ., China; Hou, Shujun, Tianjin Univ., China; Journal of Vibration Engineering; Sep. 1997; ISSN 1004-4523; Volume 10, no. 3, pp. 368-374; In Chinese; Copyright; Avail: Aeroplus Dispatch

Muszynska’s model of seal fluid dynamical forces is used to investigate the relation of the linearized stability of a single span rotor-seal system between its parameters. According to the theory of Hopf bifurcation, the instability leads to self-excited whirling motion of the rotor generated from its equilibrium position. The direction of Hopf bifurcation and the stability of the bifurcated periodic orbit are determined by Poore’s algebraic criterion. The theoretical results are verified by numerical results.
Author (AIAA)
Systems Stability; Nonlinear Systems; Rotors; Seals (Stoppers)

19980072675

A novel four-node quadrilateral smoothing element for stress enhancement and error estimation

Tessler, A., NASA Langley Research Center, USA; Riggs, H. R., Hawaii, Univ., Honolulu; Dambach, M., NASA Langley Research Center, USA; 1998, pp. 124-136; In English
Report No.(s): AIAA Paper 98-1713; Copyright; Avail: AIAA Dispatch

A four-node, quadrilateral smoothing element is developed based upon a penalized-discrete-least-squares variational formulation. The smoothing methodology recovers C exp 1-continuous stresses, thus enabling effective a posteriori error estimation and automatic adaptive mesh refinement. The element formulation is originated with a five-node macroelement configuration consisting of four triangular anisoparametric smoothing elements in a cross-diagonal pattern. This element pattern enables a convenient closed-form solution for the degrees of freedom of the interior node, resulting from enforcing explicitly a set of natural edge-wise penalty constraints. The degree-of-freedom reduction scheme leads to a very efficient formulation of a four-node quadrilateral smoothing element without any compromise in robustness and accuracy of the smoothing analysis. The application examples include stress recovery and error estimation in adaptive mesh refinement solutions for an elasticity problem and an aerospace structural component.
Author (AIAA)
Error Analysis; Stress Distribution; Data Smoothing; Spacecraft Structures; Aircraft Structures; Elastic Properties

19980072687

Flutter of an airfoil with a cubic nonlinear restoring force

Lee, B. H. K., National Research Council of Canada, Inst. for Aerospace Research, Ottawa, Canada; Jiang, L. Y., National Research Council of Canada, Inst. for Aerospace Research, Ottawa; Wong, Y. S., Alberta, Univ., Canada; 1998, pp. 237-257; In English

Report No.(s): AIAA Paper 98-1725; Copyright; Avail: AIAA Dispatch

The effect of a cubic structural restoring force on the flutter characteristics of a 2D airfoil placed in an incompressible flow is investigated. The aeroelastic equations of motion are written as a system of eight first-order ordinary differential equations. Given the initial values of plunge and pitch displacements and their velocities, the system of equations is integrated numerically using a 4th-order Runge-Kutta scheme. Results for soft and hard springs are presented for a pitch degree-of-freedom nonlinearity. The study shows the dependence of the divergence flutter boundary on initial conditions for a soft spring. For a hard spring, the nonlinear flutter boundary is independent of initial conditions for the spring constants considered. The flutter speed is identical to that for a linear spring. Limit cycle oscillation occurs for velocities greater than the flutter speed. The behavior of the airfoil is also analyzed using analytical techniques developed for nonlinear dynamical systems. The Hopf-bifurcation point is determined analytically, and the amplitude of the limit cycle oscillation in post-Hopf-bifurcation for a hard spring is predicted using an asymptotic theory. The frequency of the limit cycle oscillation is estimated from an approximate method.
Author (AIAA)

Flutter; Airfoil Oscillations; Airfoil Profiles; Incompressible Flow; Aeroelasticity

19980072689

Wind tunnel investigation of transonic limit cycle flutter

Matsushita, Hiroshi, National Aerospace Lab., Japan; Saitoh, Kenichi, National Aerospace Lab., Japan; Granasy, Peter, GE Lighting Europe, Hungary; 1998, pp. 267-273; In English

Report No.(s): AIAA Paper 98-1728; Copyright; Avail: AIAA Dispatch

Transonic wind tunnel tests were conducted for a high aspect ratio aeroelastic wing model in order to clarify bifurcation characteristics of the limit cycle oscillation (LCO). During the tests, a large amplitude LCO (LC-I) and a small amplitude LCO (LC-II) appeared as a saddle-node subcritical Hopf and supercritical Hopf bifurcation. In particular, LC-II occurred not only as a typical transonic flutter at the nominal dynamic pressure without any excitation but as another nonlinear transonic flutter through down to 10 percent lower dynamic pressure than nominal dynamic pressure by applying and removing a leading edge control surface oscillation. by changing the amplitude to control the magnitude of disturbance, an unsteady limit cycle (separatrix) can be identified which separates the domain in the phase plane, one going up to LCO and the other going down to equilibrium fixed points. LC-II vanished via a saddle-node bifurcation, which characterizes a subcritical Hopf bifurcation at a subcritical dynamic pressure range. LC-I also appeared by disengaging an active flutter control at around a nominal dynamic pressure and disappeared as a supercritical Hopf-bifurcation, as the dynamic pressure was decreased, which suggests the possibility of a change in the nature of the bifurcation.
Author (AIAA)

Wind Tunnel Tests; Transonic Flutter; Transonic Wind Tunnels

19980072706

Design optimization of stiffened composite panels with buckling and damage tolerance constraints

Wiggenraad, J. F. M., National Aerospace Lab., Netherlands; Arendsen, P., National Aerospace Lab., Netherlands; da Silva Pereira, J. M., Porto, Univ., Portugal; 1998, pp. 420-429; In English

Report No.(s): AIAA Paper 98-1750; Copyright; Avail: AIAA Dispatch

The design of stiffened, composite wing panels must satisfy a range of requirements related to performance, economy and safety. The design must be damage-tolerant to satisfy a number of different performance requirements for various states of damage. to obtain an optimum configuration satisfying these requirements simultaneously, the optimization code PANOPT was extended with a multimodel capability. The effect of damage tolerance constraints on postbuckled optimum design was established for blade-type, I-type, and hat-stiffened panels with stiffener flanges embedded in the skin. The 'classical' order of efficiency for optimized panels designed for buckling alone (hats, Is, blades) was no longer valid, as the masses of the three panel types were approximately equal. To obtain realistic damage models, the failure mechanisms and damage tolerance of the panel concept with embedded stiffeners were determined in an experimental program. Finally, the multimodel capability of PANOPT was demonstrated with the simultaneous optimization of an undamaged panel carrying design ultimate load, the same panel with a separated stiffener carrying design limit load, and the panel with a cut stiffener carrying 70 percent of the design limit load. An optimum design was found with an additional mass of only 5 percent, compared to a panel optimized for the undamaged case alone.
Author (AIAA)

Structural Design; Stiffening; Composite Materials; Buckling; Wing Panels

19980072735

Damage characteristics and residual strength of composite sandwich panels impacted with and without a compression loading

McGovan, David M., NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; 1998, pp. 713-723; In English

Report No.(s): AIAA Paper 98-1783; Copyright; Avail: AIAA Dispatch

The results of an experimental study of the impact damage characteristics and residual strength of composite sandwich panels impacted with and without compression loading are presented. Results of impact damage screening tests conducted to identify the impact-energy levels at which damage initiates and at which barely visible impact damage occurs in the impacted face sheet are discussed. Parametric effects studied in these tests include the impactor diameter, dropped-weight versus air gun-launched impactors, and the effect of the location of the impact site with respect to the panel boundaries. Residual strength results of panels tested in compression after impact are presented and compared with results of panels that are subjected to a compressive preload prior to being impacted.

Author (AIAA)

Impact Damage; Residual Strength; Sandwich Structures; Panels; Compression Loads; Aircraft Structures

19980072746

Nonlinear adaptive control of an aeroelastic system via geometric methods

Ko, Jeonghwan, Texas A & M Univ., College Station, USA; Strganac, Thomas W., Texas A & M Univ., College Station; Kurdila, Andrew J., Florida, Univ., Gainesville; 1998, pp. 819-829; In English

Report No.(s): AIAA Paper 98-1795; Copyright; Avail: AIAA Dispatch

A nonlinear control problem for suppressing flutter in a typical wing section with torsional nonlinearity is investigated. Based on earlier results by the authors, Lie algebraic partial feedback linearization is used for the construction of a nominal feedback controller. An adaptive method is used to augment the partial feedback linearization to ensure the stability of the closed-loop system under the presence of uncertainties in structural parameters of the aeroelastic model. The closed-loop system is guaranteed to be stable via the application of La Salle's invariance principle. Although the adaptive controller derived in this paper is based on a simple quasi-steady aerodynamic model, numerical experiments show that it also is stable for a fully unsteady aerodynamic model.

Author (AIAA)

Adaptive Control; Aeroelasticity; Flutter; Vibration Damping; Unsteady Aerodynamics

19980072748

Fuzzy control of an aeroelastic wing section

Karpouzian, G., U.S. Naval Academy, USA; 1998, pp. 835-840; In English

Report No.(s): AIAA Paper 98-1797; Copyright; Avail: AIAA Dispatch

A simple nonadaptive fuzzy controller is devised to stabilize an aeroelastic wing section in bending and torsion. The controller consists of an applied torque that counteracts the pitching and bending instabilities. An intuitive rule base for the input to the aeroelastic system, the displacement modes, and the required action by the controller (the applied torque), is used to simulate the stabilization process of the wing section in an otherwise unstable mode. The wing response to the controller rapidly approaches the static stable mode before the onset of instability, for the case of a wing section in pitching oscillation.

Author (AIAA)

Aeroelasticity; Bending Moments; Torsion; Wing Profiles

19980072757

Enhanced partitioned procedures for solving nonlinear transient aeroelastic problems

Farhat, Charbel, Colorado, Univ., Boulder, USA; Lesoinne, Michel, Colorado, Univ., Boulder; 1998, pp. 912-922; In English

Contract(s)/Grant(s): F49620-97-1-0059; NAG2-827

Report No.(s): AIAA Paper 98-1806; Copyright; Avail: AIAA Dispatch

We overview two sequential and parallel partitioned procedures that are popular in computational nonlinear aeroelasticity, and address their limitation in terms of accuracy and numerical stability. We propose two alternative serial and parallel staggered algorithms for the solution of coupled transient aeroelastic problems, and demonstrate their superior accuracy and computational

efficiency with the flutter analysis of the AGARD Wing 445.6. We contrast our results with those computed by other investigators and validate them with experimental data.
Author (AIAA)
Aeroelasticity; Nonlinear Systems; Computational Fluid Dynamics

19980072789

Computation of nonlinear viscous panel flutter using a fully-implicit aeroelastic solver

Selvam, R. P., Arkansas, Univ., Fayetteville, USA; Visbal, Miguel R., USAF, Research Lab., USA; Morton, Scott A., USAF, Research Lab., USA; 1998, pp. 1263-1272; In English
Report No.(s): AIAA Paper 98-1844; Copyright; Avail: AIAA Dispatch

The implicit time-accurate approach developed by Morton et al. (1997) is extended to account for structural nonlinearities in fluid-structure interactions. The flow equations are solved employing the beam-warming, alternate-direction, implicit scheme. The structural dynamic equations are solved by the Newmark-beta method in time and a finite-difference method in space. Particular attention is focused on the elimination of the lagging errors associated with the exchange of loads and deformations at the fluid-structure interface. The implementation of Newton-like subiterations allows the coupling of vastly different aerodynamic and structural integration schemes while providing enhanced numerical stability and temporal accuracy relative to traditional lagged approaches. The nonlinear flutter of a panel is chosen as a model problem in order to address relevant issues of the fluid-structure interaction methodology. The phenomenon is modeled by coupling either Euler or Navier-Stokes equations for the fluid with the nonlinear plate deformation equations. The stability boundary of a simply-supported panel is computed for both inviscid and laminar viscous flow in the transonic regime.
Author (AIAA)
Nonlinear Systems; Viscous Flow; Panel Flutter; Aeroelasticity; Fluid-Solid Interactions

19980072790

Characterization and modeling of the low strain amplitude and frequency dependent behavior of elastomeric damper materials

Brackbill, Christian R., Pennsylvania State Univ., University Park, USA; Ruhl, L. E., Pennsylvania State Univ., University Park; Lesieutre, George A., Pennsylvania State Univ., University Park; Smith, Edward S., Pennsylvania State Univ., University Park; 1998, pp. 1273-1283; In English
Contract(s)/Grant(s): NCC2-943
Report No.(s): AIAA Paper 98-1845; Copyright; Avail: AIAA Dispatch

The low-strain (0.1 to 20 percent) amplitude behavior of elastomeric materials in simple shear was investigated both experimentally and analytically. Amplitudes, temperatures (-40 to 150 F), and frequencies (0.01 to 10 Hz) were chosen to represent the working range of typical helicopter damper applications. A nonlinear model was developed to capture the combined amplitude and frequency dependence. The model extends the nonlinear Anelastic Displacement Fields (ADF) approach to include friction-type elements. These elements operate in parallel with the original ADF model. This configuration is shown to improve the performance of the ADF model over the amplitude and frequency range of interest. Experimental tests (single frequency harmonic) were conducted at several frequencies and amplitudes to support model characterization. The current model and a baseline nonlinear model (which does not include friction-type elements) were characterized using linearized material complex modulus data. The current model captures observed material behavior more accurately than the baseline model.
Author (AIAA)
Elastomers; Vibration Damping; Strain Distribution; Shear Properties; Rotary Wings

19980072792

Experimental spin testing of integrally damped composite blades

Kosmatka, J. B., California, Univ., San Diego, USA; Mehmed, O., NASA Lewis Research Center, USA; 1998, pp. 1295-1303; In English
Report No.(s): AIAA Paper 98-1847; Copyright; Avail: AIAA Dispatch

The experimental behavior of spinning laminated composite pretwisted plates (turbofan blade-like) with integral viscoelastic damping patches is investigated. Two different plate sets were examined. The first set investigated tailoring patch locations and definitions to damp specific modes on spinning flat plates as a function of rotational speed. The second set investigated damping patch size and location on specific modes of pretwisted plates. The results reveal that: (1) a significant amount of damping can be added using a small amount of damping material, (2) the damped plates experienced no failures up to the tested 28,000 g's and 750,000 cycles, (3) centrifugal loads caused an increase in bending frequencies and corresponding reductions in bending damping

levels that are proportional to the bending stillness increase, and (4) the centrifugal loads caused a decrease in torsion natural frequency and increase in damping levels of pretwisted composite plates.
Author (AIAA)
Turbine Blades; Vibration Damping; Structural Vibration; Gas Turbine Engines; Plates (Structural Members); Composite Materials

19980072794
Optimum placement of sensors for vibration measurements on turbine engine blades
Sensmeier, M. D., Sverdrup Technology, Inc., USA; Nichol, K. L., Sverdrup Technology, Inc., USA; 1998, pp. 1315-1320; In English
Report No.(s): AIAA Paper 98-1849; Copyright; Avail: AIAA Dispatch

A methodology has been developed for determining optimum sensor locations for measuring vibratory response of turbine engine structures. The method allows the instrumentation design engineer to make tradeoffs between mode identification, mode visibility, data integrity, and geometry. A genetic algorithm optimization approach which simulates the natural selection process to develop an optimum design has been implemented into a PC-based tool. An illustrative example is shown for a typical turbine engine blade. Application of this capability is not limited to turbine engine components, but will be useful for any dynamic test where instrumentation is limited.
Author (AIAA)
Position (Location); Sensors; Vibration Measurement; Turbine Engines; Genetic Algorithms

19980072808
Structural optimization with stress and aeroelastic constraints using expandable modal basis
Karpel, Mordechay, Technion - Israel Inst. of Technology, Haifa, Israel; Moulin, Boris, Technion - Israel Inst. of Technology, Haifa; Love, Michael H., Lockheed Martin Tactical Aircraft Systems, USA; 1998, pp. 1460-1468; In English
Report No.(s): AIAA Paper 98-1868; Copyright; Avail: AIAA Dispatch

Recent developments of the modal-based aeroelastic optimization approach facilitated efficient treatment of static-aeroelastic and stress constraints. The reduced-size models use LF normal modes of the baseline structure as fixed generalized coordinated throughout the optimization process. The modal approach is extended in this paper to allow the expansion of the modal basis by adding static modes generated in previous design steps. Being based on modal perturbations stored in the modal data base before the optimization process starts, the basis expansion is efficient and it converges faster to the optimal design. Numerical examples with realistic fighter-aircraft models demonstrate practical applications with CPU speed-up factors of about 10, compared to the regular discrete-coordinate approach, with negligible loss of accuracy.
Author (AIAA)
Optimization; Aeroelasticity; Modal Response; Structural Design; Stress-Strain Relationships; Aerodynamic Configurations

19980072813
Cyclic fatigue of composite airfoil structures
Minnetyan, Levon, Clarkson Univ., USA; Huang, Dade, Clarkson Univ., USA; Chamis, Christos C., NASA Lewis Research Center, USA; Abdi, Frank, AlphaStar Corp., USA; 1998, pp. 1505-1514; In English
Report No.(s): AIAA Paper 98-1876; Copyright; Avail: AIAA Dispatch

Progressive damage and fracture of a composite airfoil structure subjected to cyclic loading is evaluated via computational simulation. A computer model is utilized for the assessment of structural response, progressive fracture, and defect/damage tolerance characteristics. Critical locations for damage initiation are identified. Constituent material properties, stress, and strata limits are scaled up to the structure level to evaluate the overall damage and fracture propagation for composites. Damage initiation, growth, accumulation, and propagation to fracture due to cyclic fatigue are included in the simulations. Results show the damage progression sequence and the changes in the structural response characteristics during different degradation stages. A procedure is outlined for use of computational simulation data in the assessment of damage tolerance, determination of sensitive parameters affecting fracture, and interpretation of experimental results with insight for design decisions.
Author (AIAA)
Composite Structures; Airfoils; Cyclic Loads; Fatigue Tests; Crack Propagation

19980072820
Analysis of bonded composite patch repaired metallic structures - An overview
Rastogi, Naveen, AdTech Systems Research, Inc., USA; Soni, Som R., AdTech Systems Research, Inc., USA; Denney, Jason J.,

USAF, Wright Lab., USA; 1998, pp. 1578-1588; In English
Contract(s)/Grant(s): F33615-97-C-3211
Report No.(s): AIAA Paper 98-1883; Copyright; Avail: AIAA Dispatch

The enhancement of service life of aging aircraft fleets is currently a major concern for aircraft operators. This is necessary to ensure operational cost effectiveness and safety of these aging fleets. In recent years composite materials have found their application as a reinforcement to repair cracked and damaged metallic aircraft structures. In this paper the state of the art in the analysis of cracked metallic structures repaired by bonded composite patches are discussed, and critical issues are highlighted. This work is conducted as part of a larger effort currently under way to extend the bonded composite patch design methodology for repair of cracked/damaged metallic structures of aging aircraft fleets.
Author (AIAA)
Service Life; Composite Materials; Aircraft Maintenance; Aircraft Structures

19980072840
Finite element based analytic shape sensitivities of local and global airframe buckling constraints
Shin, Youngwon, Washington, Univ., Seattle, USA; Livne, Eli, Washington, Univ., Seattle; 1998, pp. 1772-1793; In English
Report No.(s): AIAA Paper 98-1916; Copyright; Avail: AIAA Dispatch

An examination of available shell finite elements suitable for buckling analysis of thin walled airframe structures leads to the selection of a simple, accurate, design-oriented element, which is then used with slight modifications to obtain explicit, closed-form equations for the stiffness and geometric stiffness matrices. In turn, these equations are used to derive explicit expressions for the analytic sensitivities of stiffness and geometric stiffness matrices with respect to shell shape design variables. With analytic shape sensitivities of structural matrices and corresponding buckling eigenvalues at hand, the resulting new computer capability makes it possible to construct buckling constraint approximations for approximation-concepts based structural synthesis, as well as to examine sources of numerical noise which might appear when parametric studies or finite difference sensitivities are carried out using existing FE codes. The simplicity of the shell elements used and the elimination of the need to carry out numerical integration lead to computational savings, especially when repetitive analyses have to be carried out during shape design optimization of typical airframes.
Author (AIAA)
Airframes; Finite Element Method; Buckling; Shell Theory; Structural Design

19980072855
Conditional reliability assessment of aircraft structure under repeated inspections
Pieracci, Andrea, Pisa, Univ., Italy; Rackwitz, Ruediger, Munich, Technical Univ., Germany; 1998, pp. 1919-1928; In English
Report No.(s): AIAA Paper 98-1937; Copyright; Avail: AIAA Dispatch

Reliability analysis of a wing panel undergoing repeated loading in the presence of periodic inspections with regard to fatigue damage development is considered. It is shown how the inspection strategy can be updated by inference of the results of previous observations. The effect of the different variables used to model the problem is illustrated in relation to the probability of failure of the component under consideration. The methodology proposed is a generalization of structural reliabilty methods developed for ships and offshore industries. The results obtained are also of utility in the aerospace field for both quantitative and qualitative reliability analysis under safety and cost constraints.
Author (AIAA)
Wing Panels; Reliability Analysis; Wing Loading; Fatigue Life; Nondestructive Tests; Structural Reliability

19980072868
On the presence of internal resonances in aeroelastic systems
Gilliatt, Heather C., Texas A & M Univ., College Station, USA; Strganac, Thomas W., Texas A & M Univ., College Station; Kurdila, Andrew J., Florida, Univ., Gainesville; 1998, pp. 2045-2055; In English
Report No.(s): AIAA Paper 98-1954; Copyright; Avail: AIAA Dispatch

The authors examine the presence of internal resonance in aeroelastic structures and illustrate the pathologies that internal resonance may have on these systems. These studies consider an aeroelastic model which possesses nonlinear aerodynamic loads such as those that arise from aerodynamic stall. Analyses of the equations of motion representing a physical aeroelastic structure

are presented. The aerodynamics are in quasi-steady form and implement stall effects which introduce strong cubic nonlinearities into the equations of motion. These nonlinearities lead to a 3:1 internal resonance.
Author (AIAA)
Airfoil Oscillations; Resonant Vibration; Aeroelasticity; Aerodynamic Stalling; Dynamic Structural Analysis; Aerodynamic Loads

19980072903

Buckling response of transversely loaded composite shells

Tudela, Mark A., MIT, USA; Lagace, Paul A., MIT, USA; Wardle, Brian L., MIT, USA; 1998, pp. 2403-2412; In English
Contract(s)/Grant(s): FAA-94-G-037
Report No.(s): AIAA Paper 98-1992; Copyright; Avail: AIAA Dispatch

The transverse loading response of convex composite shell structures typical of aircraft fuselage sections was investigated experimentally. Important mechanisms in the response, particularly instabilities (buckling), were studied by investigating the force-deflection response and the evolution of full-field deformation-shapes. Quasi-static tests were conducted to simulate impact of convex shells. The specimens were laminated, cylindrical shells sections in (+/- 45n/0n)s configurations where n takes on values of 1, 2, and 3. The three structural parameters of radius, span, and thickness were varied according to a scaling relation and were chosen to represent approximate fuselage dimensions of general aviation and commercial transport aircraft. All specimens were evaluated for damage using dye-enhanced X-radiography and sectioning after mechanical testing. The structural response changes both quantitatively and qualitatively for the different shell geometries and was categorized into three 'types' based on the existence of the instability transition characteristics, such as deformation shapes. The presence of the instability becomes more likely for deeper, thinner specimens where the ratio of membrane to bending stiffness is higher.
Author (AIAA)
Reinforced Shells; Composite Structures; Buckling; Transverse Loads; Fuselages; Shell Stability

19980072907

Design and validation of high temperature composite fasteners

Miller, R. J., Pratt & Whitney, USA; Moree, J. C., Pratt & Whitney, USA; Jarmon, D. C., United Technologies Research Center, USA; 1998, pp. 2444-2451; In English
Contract(s)/Grant(s): NAS3-26385
Report No.(s): AIAA Paper 98-1998; Copyright; Avail: AIAA Dispatch

A nonconventional composite fastener developed for attachment of high temperature ceramic matrix composites has been validated through extensive static and fatigue testing. The fastener was designed for applications which exceed the structural use temperature of metals, such as in nozzle components in supersonic aircraft engines. Typically cooling air is required to maintain the maximum component temperature within the operational capabilities of high temperature metals. The engine performance is reduced as the requirement for cooling air increases. The concept utilizes a rectangular fastener rather than the conventional round fastener or bolt to eliminate matrix dominated interlaminar failure modes prevalent in conventional high temperature composite fasteners. Experimental data are presented on the original concept, as well as on several modifications which increased the structural performance of the fasteners.
Author (AIAA)
Ceramic Matrix Composites; Fasteners; Static Tests; Thermal Stability; Fatigue Tests; Aircraft Engines

19980072917

Prediction of statistical dynamics of thermally buckled composite panels

Lee, Jon, USAF, Research Lab., USA; Wentz, Kenneth, USAF, Research Lab., USA; Clay, Chris, USAF, Research Lab., USA; Anselmo, Estelle, USAF, Research Lab., USA; Crumbacher, Ronald, USAF, Research Lab., USA; Vaicaitis, Rimas, Columbia Univ., New York; 1998, pp. 2539-2549; In English
Report No.(s): AIAA Paper 98-1975; Copyright; Avail: AIAA Dispatch

In hypersonic flights, a thermal loading reaching up to 2000 F and acoustic loads in the anticipated range of 135-175 dB are considered for the thermal-acoustic structural fatigue. In this paper, we report the numerical simulation of composite buckled panels heated up to 2000 F over the sound pressure range of 120-150 dB. What is new is imposing a large temperature differential across the panel thickness, which is usually found in thermal protection skin panels. We have found that not only are the rms displacement and stress/strain independent of the sound pressure at high temperatures, but they obey simple temperature relations

as the plate temperature rises. This is due to the fact that statistical panel dynamics are governed by the static snap-through displacement at high temperatures.
Author (AIAA)
Thermal Buckling; Panels; Composite Materials; Hypersonic Flight; Thermal Protection; Modal Response

19980072925

A dynamic finite element (DFE) approach for coupled bending-torsional vibrations of beams

Hashemi, S. M., Univ. Laval, Canada; Richard, M. J., Univ. Laval, Canada; Dhatt, G., Rouen, Inst. de Mecanique, France; 1998, pp. 2614-2624; In English
Report No.(s): AIAA Paper 98-2020; Copyright; Avail: AIAA Dispatch

A new DFE formulation for the coupled bending-torsion vibrational analysis of uniform beams is presented. The frequency-dependent trigonometric shape functions, corresponding to the uncoupled bending and torsional vibrations, are used to find the elementary stiffness matrix which has both mass and stiffness properties. The implementation of the derived DFE matrix in a program is discussed, with particular reference to an established algorithm. Within the limits of this method, an approach to calculate the number of constrained frequencies of a member, lying between zero and any trial frequency, is also presented. This enables coupled vibration analysis of beams, or assemblages of coupled beams, to be made. The application of the theory is demonstrated by three illustrative examples of wings of different configurations wherein a substantial amount of coupling between bending and torsion is highlighted. The correctness of the theory is confirmed, to a high degree of accuracy, by published results and numerical checks.
Author (AIAA)
Finite Element Method; Bending Vibration; Torsional Vibration; Beams (Supports); Structural Vibration; Aircraft Structures

19980072937

Application of the Concurrent Subspace Design framework to aircraft brake component design optimization

Stelmack, Marc A., Notre Dame, Univ., USA; Batill, Stephen M., Notre Dame, Univ., USA; Beck, Bryan C., AlliedSignal Aerospace, USA; Flask, David J., AlliedSignal Aerospace, USA; 1998, pp. 2750-2760; In English
Contract(s)/Grant(s): NAG1-1561
Report No.(s): AIAA Paper 98-2033; Copyright; Avail: AIAA Dispatch

The Concurrent Subspace Design (CSD) framework has been used to conduct a preliminary design optimization of an aircraft landing gear subsystem. The application required the implementation of the multidisciplinary design optimization framework with existing industrial analysis software. The CSD framework employs artificial neural networks to provide approximations to the design space, which are the means of coordinating design decisions in the individual disciplines. This approach was applied to the design of an aircraft brake actuation system which contains continuous and discrete design variables. The results demonstrate that the mixed CSD framework was able to efficiently identify improved designs. This study also demonstrated that the CSD framework can be exploited using existing engineering analysis methods.
Author (AIAA)
Aircraft Brakes; Structural Design; Aircraft Design; Optimization

19980072943

Development of a piezoceramic flight control surface actuator for highly compressed munitions

Barrett, R. M., Auburn Univ., USA; Stutts, J. C., Auburn Univ., USA; 1998, pp. 2807-2813; In English
Contract(s)/Grant(s): F08630-95-K-0079
Report No.(s): AIAA Paper 98-2034; Copyright; Avail: AIAA Dispatch

The working principles and structural arrangements of a new type of actuator specifically designed for highly compressed munitions is presented. The actuator uses pairs of piezoceramic sheets arranged in a push-pull assembly to turn a spindle of an aerodynamic control surface. to demonstrate the actuator concept, a maximum compression design for a GPS-guided Mk 83 air-to-ground weapon was conceived. by using the adaptive tendons mounted in strakes, the weapon box was shrunk to 1/8th the volume of a GBU-16, which also uses the Mk 83 warhead. Modeling of the actuators was accomplished by laminated plate theory and kinematics. A 50 percent scale experimental model was built for bench and wind tunnel testing. Bench testing showed that the 1.3 cu in., 6.5 oz. actuators could generate +/- 10 deg fin deflections with a corner frequency of 59 Hz and good correlation between theory and experiment. Torque capability of +/- 3 in.-lbf (+/- 0.34 N-m) was shown to be sufficient for loads through the transonic flight regime.
Author (AIAA)
Piezoelectric Transducers; Piezoelectric Ceramics; Flight Control; Control Surfaces; Ammunition

19980072946

Development and experimental validation of a barrel-launched adaptive munition

Stutts, J. C., Auburn Univ., USA; Barrett, R. M., Auburn Univ., USA; 1998, pp. 2834-2840; In English
Contract(s)/Grant(s): F49620-93-C-0063
Report No.(s): AIAA Paper 98-2037; Copyright; Avail: AIAA Dispatch

The development and experimental testing of a new type of flight control system for cannon rounds is presented. For the purposes of this project, a 10-deg half-angle conical two-piece model with a gimbaled nose was constructed. The nose of the BLAM (Barrel-Launched Adaptive Munition) was attached to the aft section by a set of orthogonally mounted piezoelectric tendons. Analytical models of the piezoelectric tendons used classical laminated plate theory. Aerodynamic models were based on Tsien supersonic cone theory. Actuation of the tendons pitched the nose around the ball joint, facilitating flight control. Static and dynamic bench tests indicate a maximum deflection (peak-to-peak) of 0.3 deg, and the round experienced a first natural frequency in pitch of 198 Hz. Subsequent wind tunnel tests at Mach 3.26 indicated that the round generates body-fixed normal force increments of up to +/- 0.0019, with good correlation between theory and experiment.
Author (AIAA)

Flight Control; Ammunition; Piezoelectric Transducers; Tensile Tests; Failure Modes; Wind Tunnel Tests

19980072983

Dynamic stresses in composite Timoshenko beams with application to aircraft wings

Eslimy-Isfahany, S. H. R., City Univ., UK; Banerjee, J. R., City Univ., UK; 1998, pp. 3201-3211; In English
Report No.(s): AIAA Paper 98-2085; Copyright; Avail: AIAA Dispatch

A method of dynamic stress analysis for composite Timoshenko beams is presented. Both geometric and material couplings between the bending and torsional deformations of the beam are considered. A response analysis is performed in order to obtain the dynamic flexural and torsional displacements of the beam when subjected to deterministic or random loads. These dynamic displacements together with the externally applied loads are used to calculate the time-dependent shear force, bending moment, and torque acting on the beam. The dynamic stresses at a cross section of the beam due to these loads are then computed using Engineer’s bending, Bredt-Batho, and classical lamination theories. Numerical results are given for a cantilever composite wing subjected to a uniformly distributed random load which is that of an atmospheric turbulence represented by the von Karman spectra. The example wing has substantial (material) coupling between the bending and torsional modes of deformation. The effect of ply orientation on the dynamic stresses at mid-span of the wing is demonstrated. The variation of stresses along the length of the wing (for a given ply orientation and stacking sequence) is also demonstrated.
Author (AIAA)

Timoshenko Beams; Stress Analysis; Bending Moments; Torsion; Free Vibration; Wings

19980072996

Transonic similarity rules for flutter and divergence

Bendiksen, Oddvar O., California, Univ., Los Angeles, USA; Apr. 1998; In English
Contract(s)/Grant(s): NCC2-374
Report No.(s): AIAA Paper 98-1726; Copyright; Avail: AIAA Dispatch

Aeroelastic similarity parameters and similarity rules are derived for transonic flutter and divergence. The rules are sufficiently simple to be useful in a design environment. It is shown that aeroelastic similarity cannot exist between the same aeroelastic model at different transonic Mach numbers, but can only exist between different models with the same aeroelastic similarity parameters. In order to have similar flows as the Mach number approaches one, the airfoil thickness and the angle of attack must be reduced, and the aspect ratio must be increased. For aeroelastic similarity, the mass ratio of the model must be increased as dictated by the flutter similarity parameter, while keeping the appropriate reduced frequency parameter constant. A thicker wing operation at a lower transonic Mach number is aeroelastically similar to a thinner wing of a higher mass ratio operating at a higher transonic Mach number, and vice versa.
Author (AIAA)

Transonic Flutter; Aeroelasticity; Structural Design Criteria; Similarity Theorem; Unsteady Aerodynamics

19980073006

Stall flutter and probabilistic fatigue life prediction for cascaded airfoils

Li, Xiaoguang, Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Apr. 1998; In English
Contract(s)/Grant(s): F49620-97-1-009
Report No.(s): AIAA Paper 98-1853; Copyright; Avail: AIAA Dispatch

A probabilistic stall flutter-dynamic stall generated HCF analysis for turbomachinery blading is developed to consider the stall flutter of a cantilevered flat plate, with the unsteady aerodynamics determined from a semi-empirical nonlinear dynamic stall model. The resulting probabilistic HCF model utilizes both a fracture mechanics approach and a cumulative linear fatigue damage model, with the crack size and cumulative fatigue damage index considered as random variables. A dynamic stress analysis and rainflow counting method are implemented, with a Paris' crack law describing the crack growth. The probability of failure is determined based on a cumulative linear fatigue damage model, with the cumulative damage index selected as a random variable.
Author (AIAA)
Airfoil Oscillations; Flutter Analysis; Aerodynamic Stalling; Fatigue Life; Turbine Blades

19980073009
Structures technology for future aerospace systems
Hopkins, Mark A., USAF, Research Lab., USA; Dolvin, Douglas J., USAF, Research Lab., USA; Paul, Donald B., USAF, Research Lab., USA; Anselmo, Estelle R., USAF, Research Lab., USA; Zweber, Jeffrey V., USAF, Research Lab., USA; Apr. 1998; In English
Report No.(s): AIAA Paper 98-1869; Copyright; Avail: AIAA Dispatch

This paper addresses the development of new structures and structural concepts that are lighter, have lower manufacturing costs, and require less maintenance than current aerospace structures. A vision is presented on the development of aerospace structures technology for future military aerospace systems that will include a full range of air vehicles that will be required to meet the global reach and force projection requirements set forth by the DOD. Consideration is given to some possible avenues where aerospace structures technology advances might enable future aerospace systems, such as large long-range and long-endurance aircraft, uninhabited aircraft, special operations aircraft, modular aircraft, and hypersonic vehicles. The required changes from current aircraft design philosophy fall within several categories, including design integration, virtual design and simulation, multifunctional airframe structures, and smart structures.
AIAA
Aircraft Structures; Structural Design; Aircraft Design; Composite Materials; Structural Stability

19980073016
Structural normal mode analysis of the Aluminum Testbed Cylinder (ATC)
Grosveld, Ferdinand W., NASA Langley Research Center, USA; Apr. 1998; In English
Contract(s)/Grant(s): NAS1-96014
Report No.(s): AIAA Paper 98-1949; Copyright; Avail: AIAA Dispatch

The Aluminum Testbed Cylinder (ATC) is a universal structure for evaluating structural acoustic codes, modeling techniques, and optimization methods used in the prediction of aircraft interior noise. Finite element (FE) models were developed for the components of the ATC based on the geometric, structural, and material properties of the physical test structure. A simple FE model of the ATC, including the shell, longitudinal stringers, ring frames, and fiberglass domes, was developed as a baseline configuration to obtain preliminary information on mode participation, modal density, and the frequency range of interest. Numerically predicted modal frequencies for the isolated longitudinal stringer and ring frame component models were compared with the analytical results from beam and ring formulas, with experimental modal survey data and with additional FE models. Modal frequencies of the stringer, computed with the FE beam model, showed good agreement for the first five frequencies from both an experimental modal survey and a solid element model.
Author (AIAA)
Aircraft Structures; Cylindrical Bodies; Structural Analysis; Noise Prediction (Aircraft); Test Equipment

19980073028
Analytical and finite element modeling of riveted lap joints in aircraft structure
Xiong, Y., NRC of Canada, Inst. for Aerospace Research, Ottawa, Canada; Bedair, O. K., NRC of Canada, Inst. for Aerospace Research, Ottawa; Apr. 1998; In English
Report No.(s): AIAA Paper 98-2062; Copyright; Avail: AIAA Dispatch

Modeling procedures for the stress analysis of riveted lap joints in aircraft structure are proposed using both analytical and numerical methods. In the analytical method, a complex variational approach is employed to determine the stresses in joined plates containing single or multiple loaded holes. The effects of finite geometry are taken into account by the variational formulations. An iterative scheme is carried out to handle the deformation compatibility between all joined members. In the numerical method, finite element analyses are conducted using the commercial packages MSC/Patran and MSC/Nastran. Gap elements are used to simulate the rivet-hole interactions. Both linear and nonlinear deformations are considered. The two modeling procedures are

complementary. While the analytical method is efficient for parametric studies, the numerical method is capable of dealing with relatively more complicated geometry and loading conditions. Results of several example problems are presented, and reasonably good agreement between the two modeling procedures is demonstrated.
Author (AIAA)
Aircraft Structures; Lap Joints; Riveted Joints; Finite Element Method; Stress Analysis; Variational Principles

13 GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

19980049767

Chemical conversion of subsonic aircraft emissions in the dispersing plume - Calculation of effective emission indices

Petry, H., Koeln, Univ., Germany; Hendricks, J., Koeln, Univ., Germany; Moellhoff, M., Koeln, Univ., Germany; Lippert, E., Koeln, Univ., Germany; Meier, A., Koeln, Univ., Germany; Ebel, A., Koeln, Univ., Germany; Sausen, R., Deutsches Zentrum fuer Luft- und Raumfahrt, Germany; Journal of Geophysical Research; Mar. 20, 1998; ISSN 0148-0227; Volume 103, no. D5, pp. 5759-5772; In English; Copyright; Avail: Aeroplus Dispatch

A box model representative for a mesoscale volume and three different plume models are used to estimate the chemical conversion of exhaust species of a subsonic aircraft at cruise altitude. Clearly deviating results have been obtained for instantaneous mixing of the exhaust in a box and gradual dispersion of a plume. The effect of varying daytime of release as well as the impact of changing dispersion time is studied with emphasis on the aircraft-induced O3 production. Effective emission indices are calculated which enable a correction for expanding plume effects in global or mesoscale models.
Author (AIAA)
Subsonic Aircraft; Exhaust Emission; Plumes; Air Pollution; Ozone; Atmospheric Chemistry

19980049810

High-resolution multiband passive polarimetric observations of the ocean surface

Piepmeier, Jeffrey R., Georgia Inst. of Technology, Atlanta, USA; Gasiewski, Albin J., Georgia Inst. of Technology, Atlanta; 1997, pp. 1006-1008; In English
Contract(s)/Grant(s): N00014-95-1-0426; N00014-95-1-1007; NAGW-4191; Copyright; Avail: Aeroplus Dispatch

A multiband microwave polarimetric scanning radiometer (PSR) was operating during January-March 1997 over the Labrador Sea and the Atlantic Ocean aboard the NASA/WFF P-3B aircraft. Conically-scanned brightness temperatures were observed over open ocean for a variety of wind speeds and cloud conditions. Presented here are several illustrations and applications of data obtained during the Labrador Sea experiment.
Author (AIAA)
Ocean Surface; Aircraft Instruments; Brightness Temperature; Wind Velocity Measurement; Microwave Radiometers

19980050582

Global survey of jet contrails using AVHRR data - Spatial distributions and optical property retrievals

Kliche, Donna V., South Dakota School of Mines and Technology, Rapid City, USA; Chou, Joyce, South Dakota School of Mines and Technology, Rapid City; Weiss, John M., South Dakota School of Mines and Technology, Rapid City; Christopher, Sundar A., South Dakota School of Mines and Technology, Rapid City; Welch, Ronald M., South Dakota School of Mines and Technology, Rapid City; Berendes, Todd, South Dakota School of Mines and Technology, Rapid City; Kuo, Kwo-Sen, South Dakota School of Mines and Technology, Rapid City; 1997, pp. 32-34; In English
Contract(s)/Grant(s): NAG5-2712; Copyright; Avail: Aeroplus Dispatch

Global survey of jet contrails is of major importance in the study of the atmospheric effects of aviation. Jet contrails are considered to be a subset of thin cirrus clouds. Due to their semitransparent nature, thin cirrus clouds are thought to be enhancers of the greenhouse effect: they are almost transparent to the incoming solar energy reaching the surface, and they reduce the planetary emissions to space due to their cold temperatures. However, jet contrails are considered responsible not so much for increasing cloudiness, but for enhancing the formation of natural cloudiness. In the present study, one month of daytime global AVHRR data

are used to automatically detect contrails, estimate the global frequency of occurrence of contrails, and estimate the optical depth and particle size of jet contrails.
Author (AIAA)
Contrails; Advanced Very High Resolution Radiometer; Cirrus Clouds; Optical Thickness; Jet Aircraft

19980050616

Airborne remote sensing to support precision farming

Wehrhan, Marc J. G., GSF-Research Center for Environment and Health, Germany; Selige, thomas M., GSF-Research Center for Environment and Health, Germany; 1997, pp. 101-103; In English; Copyright; Avail: Aeroplus Dispatch

Spatial variability of crops within fields depends on soil variability. This spatial distribution of plant growth conditions, detected by airborne remote sensing, can provide modelers, regional planers, and at least farmers with valuable information. Ground truth data of crop parameters were collected and related to spectral information in red, middle, and thermal IR wavebands derived from airborne scanner data. Simple regression analysis was used to obtain classification functions. The classified spectral images are compared with soil properties. Results of three years of study indicate the high applicability of the airborne remote sensing technique in order to detect the spatial variability of plant growth conditions on the field level.
Author (AIAA)
Remote Sensing; Farm Crops; Aircraft Instruments; Ground Truth; Scanners

19980053814

Experimental and numerical study on the flow over two-dimensional hills

Kim, Hyun Goo, Pohang Univ. of Science & Technology, Republic of Korea; Lee, Choung Mook; Lim, H. C.; Kyong, N. H.; Journal of Wind Engineering and Industrial Aerodynamics; Jan, 1997; ISSN 0167-6105; Volume 66, no. 1, pp. 17-33; In English; Copyright; Avail: Issuing Activity

An experimental and numerical investigation on the flow over two-dimensional hilly terrain is presented. Experiments for single hills and continuous double hills are performed in a boundary-layer wind tunnel, and mean velocity profiles, turbulence characteristics, and surface pressure distributions are measured. The numerical model developed for the present work is based on the finite-volume-method and the SIMPLEC algorithm with a non-orthogonal body-fitted grid system. Several turbulence models are tested for the validation of the prediction accuracy in separated flow cases. Comparisons of the mean velocity profiles and surface pressure distributions between the numerical predictions and the measurements show good agreement. The linear theory provides generally good prediction of speed-up characteristics at the hill top for the hill slope of 0.3, which is defined as the ratio of the hill height to the base length at the upwind mid-height of the hill. Flow separation occurs in the hill slope of 0.5, and the measured reattachment points are compared with the numerical prediction. The low-Reynolds-number model with an orthogonal grid is found to predict the separated flow better than the other turbulence models.
Author (EI)
Boundary Layers; Wind Tunnels; Wind (Meteorology); Computerized Simulation; Fluid Flow; Turbulence; Velocity Measurement

19980055201 Boeing Commercial Airplane Co., Seattle, WA USA

Aircraft Emission Scenarios Projected in Year 2015 for the NASA Technology Concept Aircraft (TCA) High Speed Civil Transport

Baughcum, Steven L., Boeing Commercial Airplane Co., USA; Henderson, Stephen C., Boeing Commercial Airplane Co., USA; Mar. 1998; 42p; In English
Contract(s)/Grant(s): NAS1-20220; RTOP 537-09-23-02
Report No.(s): NASA/CR-1998-207635; NAS 1.26:207635; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the development of a three-dimensional database of aircraft fuel burn and emissions (fuel burned, NOx, CO, and hydrocarbons) from projected fleets of high speed civil transports (HSCTs) on a universal airline network. Inventories for 500 and 1000 HSCT fleets, as well as the concurrent subsonic fleets, were calculated. The HSCT scenarios are calculated using the NASA technology concept airplane (TCA) and update an earlier report. These emissions inventories are available for use by atmospheric scientists conducting the Atmospheric Effects of Stratospheric Aircraft (AESA) modeling studies. Fuel burned and emissions of nitrogen oxides (NOx as NO2), carbon monoxide, and hydrocarbons have been calculated on a 1 degree latitude x 1 degree longitude x 1 kilometer pressure altitude grid and delivered to NASA as electronic files.
Author
Aircraft Fuels; Emission; Supersonic Transports; Atmospheric Effects; Airline Operations; Ozonosphere; X-30 Vehicle

19980055403

A comparison of system loads and responses between variable and constant speed operation

Moroz, Emil, Texas, Univ., El Paso, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0053; Copyright; Avail: Aeroplus Dispatch

This paper presents a first order analysis that highlights the differences in system loads and responses between wind turbines under constant and wide range variable speed operation. In all cases the study restricts itself to the rising part of the power curve and assumes that the rated power of the generator is not exceeded. The general trends are expected to be applicable to all scales of wind turbines operating away from stall.

Author (AIAA)

Wind Turbines; Aerodynamic Loads; Wind Velocity

19980055648

An integrated approach to clear-air turbulence prediction

Sharman, Robert, National Center for Atmospheric Research, USA; Cornman, Larry, National Center for Atmospheric Research, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0382; Copyright; Avail: Aeroplus Dispatch

This paper discusses efforts ongoing at NCAR to integrate new observation techniques with various turbulence forecasting algorithms. The observation techniques allow timely nowcasts and provide quantitative data for forecast verifications. The forecasting technique uses fuzzy logic to merge many turbulence forecast indices together, taking into account known regions of validity (in terms of time and space, and also in terms of the details of the synoptic environment) of the various component algorithms, and weights each component accordingly to determine the final forecast.

Author (AIAA)

Clear Air Turbulence; Flight Safety; Aviation Meteorology; Numerical Weather Forecasting

19980055957

Atmospheric considerations for uninhabited aerial vehicle (UAV) flight test planning

Teets, Edward H., Jr., Analytical Services & Materials, Inc., USA; Donohue, Casey J., Analytical Services & Materials, Inc., USA; Underwood, Ken, AeroVironment, Inc., USA; Bauer, Jeffrey E., NASA, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0748; Copyright; Avail: Aeroplus Dispatch

Atmospheric considerations are a key element in support of uninhabited aerial vehicle (UAV) flight testing. The local atmospheric environment (wind speed and direction, wind shear, temperature, precipitation, and turbulence) must be characterized and understood. The primary objective is to ensure safety of the vehicle, test range, and ground assets. The generalized atmospheric behavior for any potential flight operations site is best described by combining the local seasonal climatology, daily upper atmospheric wind and temperature profiles, and hourly surface and low-level wind observations. This paper describes a continuous forecast update process based on monitoring atmospheric turbulence with surface and low-level wind for the support of UAV flights. Updates ensure the most current available data needed for mission planning. Each mission plan is developed so as not to exceed operation limits because of weather conditions. This paper also discusses climatology, weather forecasts, and day-of-flight weather monitoring for planning of uninhabited aerial vehicle missions.

Author (AIAA)

Pilotless Aircraft; Flight Tests; Aviation Meteorology; Wind Velocity; Wind Shear; Atmospheric Turbulence

19980056474

Helicopter public acceptance - How important is virtual noise?

Leverton, John W., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Objections to helicopters and helicopter operations have continued to trouble the operators even though over the years the noise levels of helicopters particularly the smaller helicopters have continued to be reduced and operational procedures such as defined in the Helicopter Association International (HAI) Fly Neighborly program, has been widely introduced throughout the industry. The majority of the focus against the industry is, on the surface, related to helicopter noise. In this paper evidence presented which shows that helicopter noise is rated differently by the general public and that there is a strong non-acoustic component, which is termed virtual noise. This leads to design considerations and operational procedures, and a focus on public education program to reduce the virtual noise, which will have to be adopted by the industry if it is to obtain wide public acceptance of helicopters in the community.

Author (AIAA)

Helicopter Performance; Aircraft Noise; Noise Pollution; Operator Performance

19980059136

Design of the NCAR Weather Avoidance Radar Data System and geostationary radar flight track display

Walther, Craig, NCAR, USA; Neitzel, Rich, NCAR, USA; Randall, Mitch, NCAR, USA; 1997, pp. 224, 225; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the design features of the Weather Avoidance Radar Data System (WARDS). The performance offered by a combination of WARDS with a geostationary display and snapshot viewing capabilities aboard the NCAR Electra aircraft is also evaluated.

AIAA

Meteorological Radar; Radar Antennas; Airborne Radar; C-130 Aircraft; Radar Receivers; Radar Transmitters

19980059157

Spatio-temporal characteristics of radar volume reflectivity in wingtip generated wake vortices in clear air

Marshall, Robert E., Research Triangle Inst., USA; Mudukutore, Ashok S., Research Triangle Inst., USA; 1997, pp. 266, 267; In English

Contract(s)/Grant(s): NAS1-18925; Copyright; Avail: Aeroplus Dispatch

The NASA Terminal Area Simulation System (TASS) has been modified to predict the mean wind and thermodynamic variables for aircraft 2D wakes with a 1-m resolution. The TASS-derived turbulent kinetic energy dissipation rate and kinematic viscosity have been used to calculate the Kolmogorov microscale and a corresponding maximum radar frequency at each grid point within aircraft wakes.

AIAA

Radar Reflectors; Wing Tip Vortices; Aircraft Wakes; Turbulence

19980059169

Characteristics of thunderstorm induced gravity waves using Doppler radar and tower instrumentation

Miller, David W., MIT, USA; Boorman, Benjamin G., MIT, USA; Ferris, Richard F., MIT, USA; Rotz, Timothy M., MIT, USA; 1997, pp. 165-167; In English; Copyright; Avail: Aeroplus Dispatch

The present study of the formation and propagation of low-level gravity waves notes that they occur in apparently benign weather conditions, leading unsuspecting pilots into danger. It is shown that the ideal conditions for formation of gravity waves are predictable on the basis of atmospheric profiles obtained by combined Doppler radar and meteorological tower data.

AIAA

Thunderstorms; Gravity Waves; Doppler Radar; Wave Propagation; Aircraft Accidents

19980059229

Radar reflectivity factor in the wakes of aircraft in fogs

Marshall, Robert E., Research Triangle Inst., USA; Mudukutore, Ashok S., Research Triangle Inst., USA; 1997, pp. 159, 160; In English

Contract(s)/Grant(s): NAS1-18925; Copyright; Avail: Aeroplus Dispatch

Doppler radar has been suggested as a remote sensor for aircraft wake vortex quantification in adverse weather, with a view to the dynamic adjustment of wake vortex separation distances between aircraft at takeoffs and landings. Results are presented from predictions of the radar reflectivity factor in the wakes of aircraft flying in fogs.

AIAA

Fog; Aircraft Wakes; Wing Span; Radar Reflectors; Drop Size

19980059230

Simulation of radar observed wingtip generated wake vortices in fog

Mudukutore, Ashok S., Research Triangle Inst., USA; Marshall, Robert E., Research Triangle Inst., USA; 1997, pp. 161, 162; In English

Contract(s)/Grant(s): NAS1-18925; Copyright; Avail: Aeroplus Dispatch

The present radar simulation attempts to model aircraft wingtip wake vortex returns in the presence of ground clutter and noise. The reflectivity model used assumes backscattering from a rain and cloud-droplet Rayleigh target environment. A Ka-band pulsed Doppler radar is simulated for the wake generated by a C-5A airlifter.

AIAA

Computerized Simulation; Radar Tracking; Wing Tip Vortices; Fog; Aircraft Wakes

19980059250

The accuracy of vertical air velocities from Doppler radar data

Matejka, Thomas, NOAA, National Severe Storms Lab., USA; Bartels, Diana L., NOAA, National Severe Storms Lab., USA; 1997, pp. 87, 88; In English; Copyright; Avail: Aeroplus Dispatch

Experiments have been conducted to test the robustness to different data errors of eight methods for the computation of vertical air velocity. Attention is given to the responses of the methods both to random and systematic errors, where method performance is a function of error magnitude and degree of nonrandomness.

AIAA

Airspeed; Doppler Radar; Error Analysis

19980062384

Vertical motions in deep convective storms observed with EDOP during CAMEX-2

Heymsfield, G. M., NASA Goddard Space Flight Center, USA; Caylor, I. J., Science Systems & Applications, Inc., USA; Bidwell, S. W., NASA Goddard Space Flight Center, USA; 1997, pp. 563, 564; In English; Copyright; Avail: Aeroplus Dispatch

The characteristics of deep convection are presented for remnants of tropical storm Jerry over the ocean, on the basis of data obtained from the NASA ER-2 Doppler radar's high resolution measurements. Attention is given to such questions as the definition of the updrafts and whether the upper-level downdrafts were dynamically driven.

AIAA

Storms; Aircraft Instruments; Doppler Radar; Airborne Radar

19980063491

Predicted performance of Cierva-rotor wind turbines

Kentfield, J. A. C., Univ. of Calgary, Canada; Brophy, D. C.; Wind Engineering; 1997; ISSN 0309-524X; Volume 21, no. 2, pp. 89-101; In English; Copyright; Avail: Issuing Activity

The performance was predicted of a wind-turbine, intended for electrical power generation, rotor of which is similar in configuration to the rotor of an autogyro or gyrocopter as originated by Cierva. Hence the rotor axis of spin is tilted downwind, for maximum power production, by an angle of 40 deg to 50 deg relative to the vertical with power regulation by modulation of the tilt angle. Because the rotor of a Cierva turbine generates lift the simple, non-twisted, fixed-pitch blades 'fly' and are self supporting thereby eliminating flap-wise bending moments when the blades are hinged at their roots. It was found from the analysis that it is possible to reduce tower bending moments relative to a conventional horizontal axis turbine of equal power output and also, for equal maximum hub heights and blade tip altitudes, a Cierva turbine is capable, at a prescribed wind speed, of a greater power output than a conventional horizontal axis machine. For example a Cierva rotor 56% greater in diameter than an otherwise comparable conventional horizontal axis rotor of equal solidity has a maximum output approximately 100% greater close to the cut in wind speed of 4 m/s dropping to about 50% greater at 12 m/s.

Author (EI)

Wind Turbines; Windpower Utilization; Electric Generators; Rotors; Turbomachine Blades

19980063629

Seasonal circulation in the South Indian Ocean

Ffield, Amy, Lamont-Doherty Earth Observatory, USA; Toole, John; Wilson, Doug; Geophysical Research Letters; Nov 15, 1997; ISSN 0094-8276; Volume 24, no. 22, pp. 2773-2776; In English; Copyright; Avail: Issuing Activity

Two World Ocean Circulation Experiment hydrographic cruises in March and June 1995, along with Topex-Poseidon altimeter data and National Meteorological Center wind data are used to estimate seasonal changes in the South Indian Ocean subtropical gyre. Mean annual curves derived from the altimeter and wind data reveal strengthening of the anticyclonic gyre in March and September, and weakening in June and December. The seasonal changes correspond to variations in the wind field south of 30 deg S at the equinoxes and solstices. In addition, the wind-driven gyre is further north in July, and further south in March. These variations in strength and location of the South Indian Ocean gyre may influence inter-ocean transports south of Africa. Despite the inferred mean annual seasonal variations in the South Indian Ocean gyre, volume transports estimated in 1995 from the hydrographic data are close to mean values. Apparently, a mesoscale eddy in March disrupts the stronger fall gyre, whereas in June the weaker winter gyre is delayed by 1 month.

Author (EI)

Indian Ocean; Ocean Currents; Hydrography; Surveys; Wind (Meteorology); Altimeters

19980064192

On separating space and time variations or auroral precipitation - Dual DMSP-F6 and -F8 observations

Jorgensen, A. M., Boston Univ., USA; Spence, H. E., Boston Univ., USA; Advances in Space Research; Aug. 1997; ISSN 0273-1177; Volume 20, no. 3, pp. 453-456; In English

Contract(s)/Grant(s): NAGW-3953; Copyright; Avail: Aeroplus Dispatch

An analysis of DMSP-F6 and -F8 satellite data demonstrates the value of two-point measurements of the dynamics of auroral precipitation on minute timescales, since single satellite measurements will always suffer from the space/time ambiguity. The results emphasize the importance of separating the two and the possiblity of reaching erroneous scientific conclusions by interpreting a single pass or a single point measurement without knowledge of the time evolution of the phenomenon.

AIAA

Auroral Zones; Particle Precipitation; DMSP Satellites; Satellite Observation; F-8 Aircraft; Plasma Dynamics

19980064343

Statistical properties of global significant wave heights and their use for validation

Bauer, Eva, Potsdam Inst. for Climate Impact Research, Germany; Staabs, Christoph, Hamburg, Univ., Germany; Journal of Geophysical Research; Jan. 15, 1998; ISSN 0148-0227; Volume 103, no. C1, pp. 1153-1166; In English; Copyright; Avail: Aeroplus Dispatch

Global data sets of significant wave height (Hs) from altimeter measurements and from the wave model WAM are analyzed statistically to assess the quality of the data. Hs derived from the altimeters aboard Seasat (1978), Geosat (1988), ERS-1 (1993, 1994), and TOPEX (1993, 1994) and from WAM (1988, 1993) and, in addition, from in situ data of Ocean Weather Station M in the North Atlantic are used. First, collocated data sets are compared through linear regression and principal component analysis. From this, a good agreement between Hs of the ERS-1 altimeter (1993) and the WAM model is inferred. Second, the Hs frequency distributions are described by the first four moments. Using the first four moments of linear order statistics, the lognormal and the general extreme value distribution function are found to approximate distributions of Hs best. Hs from Seasat and ERS-1 (1993) deviate from these empirical distribution functions, manifesting weaknesses in the data. Although Hs from ERS-1 have weaknesses, their assimilation into WAM has a positive impact. The assessment of the quality of this existing Hs data provides a prerequisite for the coming assimilation schemes using wave data from synthetic aperture radars and also for climate research studies.

Author (AIAA)

Sea States; Water Waves; Statistical Distributions; Altimeters; Ocean Dynamics

19980064487

The SABER Microwave-Powered Helicopter Project and related WPT research at the University of Alaska Fairbanks

Hawkins, Joe, Alaska, Univ., Fairbanks, USA; Houston, Shawn, Alaska, Univ., Fairbanks; Hatfield, Michael, Alaska, Univ., Fairbanks; Brown, William, MPT Systems, USA; 1998, pp. 1092-1097; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the current status of three projects at the University of Alaska Fairbanks with potential applications to solar power satellites (SPS). The Semi-Autonomous BEam Rider (SABER) project is a model helicopter powered by a 1-hp electric motor and a rotor with a diameter of 1.15 m. It receives the power necessary to hover from a 1-kW microwave transmitter operating at 2.45 GHz. This project is intended to provide a test bed for the development of wireless power transmission (WPT) technology and an easily transportable demonstration of this technology. The power is received by an array of rectenna elements mounted beneath the helicopter. The ultimate goal is to integrate sensor and control subsystems onto the helicopter to measure the helicopter’s attitude and position, and allow it to autonomously hover over the incident microwave beam. A second project consists of the continued refinement of a magnetron directional amplifier (MDA) to provide an efficient, high-power microwave source with independent control of phase and amplitude.

Author (AIAA)

Solar Power Satellites; Helicopters; Microwave Power Beaming; Helicopter Control

19980064829

A regression model for the turbulence with reference to wind turbine classes defined in IEC 1400-1

Holley, William E., USA; 1998, pp. 262-272; In English

Report No.(s): AIAA Paper 98-0056; Copyright; Avail: Aeroplus Dispatch

The standard wind turbine classes defined in IEC 1400-1 have specified external conditions, including wind speed and turbulence, which are required for analysis of design loads. In this paper, turbulence data from two representative sites, one in San Gorgonio Pass, California, and the other near Ainsworth, Nebraska are analyzed. Each data set was collected over a whole year and

was part of the DOE Turbulence Characterization Program originally managed by the Pacific Northwest Laboratory (PNL). In IEC-1400-1 a linear relation between the turbulence standard deviation, and the average wind speed is prescribed for the standard wind turbine classes. This paper describes the underlying regression model and applies the results to data for the two sites. An often overlooked feature in the analysis of turbulence data is the effect of trends in the time series. An approximate method for accounting for the effect of trends after the average data is logged, developed, and applied to the data from the two sites. The application of this adjustment for trends, however, does not significantly affect the results in the cases analyzed.
Author (AIAA)
Wind Turbines; Regression Analysis; Turbulence Effects; Time Series Analysis; Structural Design; Aerodynamic Loads

19980064832
Site specific design optimization of wind turbines
Fuglsang, Peter, Riso National Lab., Denmark; Thomsen, Kenneth, Riso National Lab., Denmark; 1998, pp. 294-303; In English
Report No.(s): AIAA Paper 98-0059; Copyright; Avail: Aeroplus Dispatch

A method is presented for site specific design of wind turbines where cost of energy is minimized. A numerical optimization algorithm was used together with an aeroelastic load prediction code and a cost model. The wind climate, including simulated turbulence, is described in detail. Response time series were calculated for relevant load cases, and lifetime equivalent fatigue loads were derived. For the fatigue loads, an intelligent sensitivity analysis was used to reduce computational costs. Extreme loads were derived from statistical response calculations of the Davenport type. A comparison of a 1.5-MW stall regulated wind turbine in normal on-shore flat terrain and in an off-shore wind farm showed a potential increase in energy production of 28 percent for the off-shore wind farm but also significant increases in most fatigue loads and in cost of energy. Compared to an on-shore optimization, the off-shore optimization increased swept are and rated power, whereas hub height was reduced.
Author (AIAA)
Wind Turbines; Aeroelasticity; Aerodynamic Loads; Structural Design

19980064868
An examination of two tower-shadow modelling strategies for downwind wind turbines
Wang, Tongguang, Glasgow, Univ., UK; Coton, Frank N., Glasgow, Univ., UK; Galbraith, Roderick A. McD., Glasgow, Univ., UK; 1998, pp. 20-30; In English
Report No.(s): AIAA Paper 98-0022; Copyright; Avail: Aeroplus Dispatch

TNs paper outlines two strategies for the calculation of the aerodynamic loadings associated with tower shadow on downwind turbines. It is shown that an initial estimate of tower shadow effects can be obtained by the inclusion of a velocity deficit representation within an unsteady prescribed wake model. This approach is, however, compromised by the trade off between efficient computation and azimuthal resolution, so much so, that the computational overhead associated with accurate dynamic calculations in the tower shadow region is prohibitive. A new and very efficient near wake representation is introduced to specifically address the tower shadow problem and to, thus, provide a basis for calculation of the associated unsteady response. This new model is integrated into the prescribed wake method to produce a hybrid scheme capable of predicting global turbine performance characteristics, together with the detailed unsteady response in the tower shadow region, at low computational cost. In this paper, the calculated results from the high resolution model are compared with those from the low resolution strategy and with field data.
Author (AIAA)
Wind Turbines; Aerodynamic Loads; Unsteady Aerodynamics; Horizontal Orientation; Atmospheric Turbulence; Near Wakes

19980064872
Prediction of ice accretion and performance degradation of HAWT in cold climates
Brahimi, M. T., Ecole Polytechnique, Canada; Chocron, D., Ecole Polytechnique, Canada; Paraschivoiu, I., Ecole Polytechnique, Canada; 1998, pp. 60-69; In English
Report No.(s): AIAA Paper 98-0026; Copyright; Avail: Aeroplus Dispatch

This paper develops a computer code capable of simulating the shape and amount of ice which may accumulate on horizontal axis wind turbine blades during operation in icing conditions. The resulting code is capable of predicting and simulating the formation of ice in rime and glaze conditions, calculating the flow field and particle trajectories, and performing thermodynamic analysis. It also makes it possible to study the effect of different parameters that influence ice formation, such as temperature, liquid water content, droplet diameter, and accretion time. The analysis was conducted on different typical airfoils, as well as on NASA/

DOE Mod-0 wind turbine. Results showed that ice accretion on wind turbines may reduce the power output by more than 20 percent.
Author (AIAA)
Wind Turbines; Ice Formation; Turbine Blades; Cold Weather; Airfoil Profiles

19980064878

Effects of coupled rotor-tower motions on aerodynamic control of fluctuating loads on light-weight HAWTS

Eggers, A. J., Jr., RANN, Inc., USA; Ashley, H., RANN, Inc., USA; Chaney, K., RANN, Inc., USA; Rock, S. M., RANN, Inc., USA; Digumarthi, R., RANN, Inc., USA; 1998, pp. 113-122; In English
Report No.(s): AIAA Paper 98-0035; Copyright; Avail: Aeroplus Dispatch

This paper extends earlier work by the authors to include effects of coupled rotor-tower motions on aerodynamic control of fluctuating loads on lightweight HAWTs. The purpose of these investigations is to assess the effectiveness of this type control in closed-loop actuation to increase structural fatigue life. The present study considers a light-weight teetered rotor mounted atop a 'soft' tower cantilevered at its base, and attention is focused on coupled flatwise motions. The fiberglass rotor blades have full-span pitch control. The primary concern is the control of fluctuating loads due to turbulent winds during rotor operation. It is found that, in open-loop operation, blade motion becomes increasingly out of phase with tower motion at frequencies approaching 4 rad/s, and these motions are essentially 180 deg out of phase at 4 rad/s and above. Tower motion is near negligible at frequencies near the blades' first free vibration mode of 8 rad/s, and near maximum as expected near the tower's first free vibration mode of 4 red/s. With pure integral control and 10 rad/s bandwidth, it is indicated that blade root fatigue life may be increased by over a factor of 10 exp 4 - essentially the same as with no tower motion. This same control has no substantial effect, however, on increasing tower base fatigue life.
Author (AIAA)
Wind Turbines; Rotor Aerodynamics; Aerodynamic Loads; Load Distribution (Forces); Fatigue Life; Feedback Control

19980064887

Operational experience with a 250 kW teetered rotor wind turbine on an inland New England ridge top

Manwell, James F., Massachusetts, Univ., Amherst, USA; Rogers, Anthony, Massachusetts, Univ., Amherst; Ellis, Anthony, Massachusetts, Univ., Amherst; Goldstein, Daniel, Massachusetts, Univ., Amherst; 1998, pp. 201-211; In English
Report No.(s): AIAA Paper 98-0047; Copyright; Avail: Aeroplus Dispatch

This paper summarizes the experiences associated with the operation of an ES-180, a 250-kW teetered rotor wind turbine on an inland ridge top in Western Massachusetts. The project is introduced in the context of earlier efforts to introduce wind turbines to New England, dating back to the 1930s. The initial expectations for turbine operation are summarized. Actual operating experience has shown that the turbine can work well under the conditions encountered, but not without substantial modifications. The specific conditions that affect operation include: the climate (cold weather, ice, and humidity); the winds at the site (extreme winds, upslope components, vertical and horizontal wind shear, directional effects, and turbulence); the site itself (limited access, requirements for remote operation and monitoring, and environmental protection factors). The paper discusses how the site conditions have affected overall turbine operation, as well as the functioning and requirements for modification of various components. Particular attention is focused on the hub, the shaft brake, the tip flaps, and the controller.
Author (AIAA)
Wind Turbines; Rotor Blades; Cold Weather; Wind Shear; Windpower Utilization; Aerodynamic Brakes

19980065059

Environmental conditions required for contrail formation and persistence

Jensen, Eric J., NASA Ames Research Center, USA; Chan, Roland, NASA Ames Research Center, USA; Toon, Owen B., Colorado, Univ., Boulder; Kinne, Stefan, Bay Area Environmental Research Inst., USA; Sachse, Glen W., NASA Langley Research Center, USA; Anderson, Bruce E., NASA Langley Research Center, USA; Gandrud, Bruce, National Center for Atmospheric Research, USA; Heymsfield, Andrew, National Center for Atmospheric Research, USA; Miake-Lye, Richard C., Aerodyne Research, Inc., USA; Journal of Geophysical Research; Feb. 27, 1998; ISSN 0148-0227; Volume 103, no. D4, pp. 3929-3936; In English; Copyright; Avail: Aeroplus Dispatch

The ambient temperatures and humidities required for contrail formation and persistence are determined from in situ measurements during the Subsonic Aircraft: Contrail and Cloud Effects Special Study (SUCCESS) experiment. Ambient temperatures and water vapor concentrations were measured with the meteorological measurement system, a laser hygrometer, and a cryogenic hygrometer (all onboard the DC-8). The threshold temperatures are compared with theoretical estimates based on simple models of plume evolution. Observed contrail onset temperatures for contrail formation are shown to be 0-2 K below the liq-

uid-saturation threshold temperature, implying that saturation with respect to liquid water must be reached at some point in the plume evolution. Visible contrails observed during SUCCESS persisted longer than a few minutes only when substantial ambient supersaturations with respect to ice existed over large regions. On some occasions, contrails formed at relatively high temperatures (not less than -50 C) due to very high ambient supersaturations with respect to ice (of the order of 150 percent).
Author (AIAA)
Environment Pollution; Contrails; Water Temperature; Cloud Physics; Exhaust Gases; Aircraft Engines

19980065464

Pedestrian level wind criteria using the equivalent average

Durgin, Frank H.; Journal of Wind Engineering and Industrial Aerodynamics; Mar, 1997; ISSN 0167-6105; Volume 66, no. 3, pp. 215-226; In English; Copyright; Avail: Issuing Activity

High-average winds, gustiness, or a rarely occurring peak gust can make a location be perceived as windy. The equivalent average combines the effects of these three types of winds into one parameter. New criteria using the equivalent average have been developed covering the five commonly used categories of pedestrian activity. The new criteria assumes k = 2 in the Weibull Distribution formula over the range of probabilities from 0.25% to 20%. It is common practice to define criteria at one probability level. If k does not equal 2 in the Weibull Distribution fit to the actual data, the smallest errors over the applicable range of probabilities, occur when the categories are defined at about the 5% occurrence level.
Author (EI)
Wind (Meteorology); Weibull Density Functions; Probability Theory; Wind Tunnels

19980068633

Technology review of aeroengine pollutant emissions

Wulff, A., Berlin, Technische Univ., Germany; Hourmouziadis, J., Berlin, Technische Univ., Germany; Aerospace Science and Technology; 1997; ISSN 0034-1223; Volume 1,, no. 8, pp. 557-572; In English; Copyright; Avail: Aeroplus Dispatch

The reduction of aircraft emissions encompasses a variety of scientific and technological problems. The concerns about atmospheric effects have been based largely on laboratory information and experience from weather and climate simulations. Research carried out over the past few years will improve the understanding of physical and chemical interaction phenomena and will support regulatory activities. Operational changes of airline flight profiles would be of benefit to the reduction of NO(x) released into the stratosphere, but would probably involve a major economic penalty. Emissions reductions through improved engine technology offer an overall potential of 10 percent lower fuel burn, but will also require a considerable component-development effort and investment. Combustion technology appears most promising, and industry is concentrating research in this area. Over the past two decades smoke emissions have become negligible, and oxides of nitrogen have been reduced by 50 percent. Staged combustion and emerging lean-premix and rich-burn/quick-quench/lean-burn technologies are potentially good for another 50 percent reduction. Alternative gaseous fuels will become of interest only in the context of a necessity to generally replace crude oil-derived fuels.
Author (AIAA)
Gas Turbine Engines; Air Pollution; Jet Exhaust; Exhaust Emission; Pollution Control; Technology Assessment

19980071366

Extracting meteorological data from projectile trajectory

Cooper, Gene R., U.S. Army, Research Lab., USA; Fansler, Kevin S., U.S. Army, Research Lab., USA; Oskay, Vural, U.S. Army, Research Lab., USA; Journal of Spacecraft and Rockets; Dec. 1997; ISSN 0022-4650; Volume 34, no. 6, pp. 769-773; In English; Copyright; Avail: Aeroplus Dispatch

Atmospheric conditions are found by knowing only the projectile’s flight trajectory and its aerodynamic coefficients together with the initial atmospheric conditions on the ground. The test trajectories were generated as solutions of the modified point mass equations of motion. The correct atmospheric conditions for the generated flight trajectory are obtained from data collected during a weather balloon flight. A nonlinear least squares method was used to fit the modified point mass equations to the test trajectory by varying the meteorological parameters. Density, temperature, and wind profiles agreed well.
Author (AIAA)
Projectiles; Flight Paths; Meteorology; Data Acquisition; Trajectory Analysis; Aerodynamic Coefficients

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19980048994 Advisory Group for Aerospace Research and Development, Aerospace Medical Panel, Neuilly-Sur-Seine, France
Injury Prevention in Aircraft Crashes: Investigative Techniques and Applications ***La Prevention des Lesions Lor des Accidents d'Avions: Les Techniques d'Investigation et Leurs Applications***
Feb. 1998; 100p; In English, 24-25 Nov. 1997, Farnborough, Madrid, UK, Spain; Also announced as 19980048995 through 19980049001
Report No.(s): AGARD-LS-208; ISBN 92-836-1068-7; Copyright Waived; Avail: CASI; A05, Hardcopy; A02, Microfiche

This Lecture Series addresses a critical aspect of the investigations related to the factors implied in the prevention of potential injuries among aircraft occupants as a consequence of impact and post-crash fires, heat and toxic fumes. It comprises a review of the critical aspects of injury prevention. The topics covered included a description of the acceleration vectors involved, how they may have an influence on the aircraft, and how the acceleration forces might be tolerated by the aviator. In addition, the physical analysis of impact and crash survivability is discussed, focusing on what happens during a mishap. Furthermore a review is made on how to evaluate the tolerable deceleration forces and occupiable space required to sustain life. A part of this LS is devoted to answering questions such as, when did the injury occur, the nature of the forces that produced the injury, and their relationship to a mishap. Injury types related to the thermal and intrusive impact of the deceleration forces are also discussed, as are aspects related to the collection of medical information that would help identify the potential causes and the effects of an individual; in particular, the way in which the occupant moves in response to the forces applied. These forces may have a profound effect upon the nature and severity of the injury. This Lecture Series, sponsored by the Aerospace Medicine Panel of AGARD, has been implemented by the Consultant and Exchange Program.
Author
Aircraft Accidents; Aircraft Accident Investigation; Crashworthiness; Design Analysis; Escape Systems; Injuries; Prevention; Human Tolerances

19980048997 Biodynamic Research Corp., San Antonio, TX USA
Principles of Crash Survivability
Raddin, James H., Jr., Biodynamic Research Corp., USA; Feb. 1998; 8p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

A comprehensive review of the history of impact protection is clearly beyond the scope of the review. The interested reader is referred to the bibliography for the chapter on Biodynamics: Transitory acceleration in DeHart's Fundamentals of Aerospace Medicine. Suffice is to say here that the endeavor or protect occupants in aircraft crashes began with the pioneers of aviation and continues to the present day. It has met with considerable success but remains limited by the remarkable violence that can be wrought when fast moving objects meet fixed ones. The human body has a meager ability to cope with such violence without assistance and practical methods of assistance can only go so far. The basic line os attack on the problem have generally been to provide a container to surround the occupant, provide a seat and restraint to hold him there, limit the accelerations of the container to tolerable levels, provide personal protective equipment such as helmets, and control for post-crash factors such as fire or water landing. Ejection seats, capsules or modules were something of a special case, since they were intended to allow the occupant to avoid the crash altogether. However, they posed their own set of risks such as the ejection accelerations, windblast, altitude exposure, parachute opening shock, parachute landing, and a host of others. They made a real contribution in many cases, but they didn't make the problem of impact injury go away.
Derived from text
Aircraft Accidents; Constraints; Protection; Ejection Seats; Helmets; Human Body; Crashes; Survival

19980048998 Biodynamic Research Corp., San Antonio, TX USA
The Physical Basis of Impact Injury and its Prevention
Raddin, James H., Jr., Biodynamic Research Corp., USA; Feb. 1998; 6p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Effective prevention of injury in aircraft crashes and the investigation into injury occurrence in those crashes requires a knowledge of how impact injury occurs and how protective techniques work. This review will examine the physical underpinnings of the art of impact protection as applied to vehicular impacts. The same principles apply to terrestrial vehicles, aircraft, and spacecraft in a wide range of impacts and other sudden accelerations. Because they happen so rapidly, they are sometimes difficult to understand in terms of our slower moving daily experience. Some of the understandings may even be counter-intuitive as a result

of the need to observe the event from various frames of reference. The review must therefore begin with some basic physics and apply those principles to the collision event. Approaches to describing crash motions and crash severity will be outlined before describing how to analyze occupant motions in a crash. The physics of injury will be briefly reviewed and applied in defining injury mechanisms and injury criteria. Finally, general approaches to crash protection will be addressed along with some perspectives on how to analyze and assess the effectiveness of crash protection. Example cases will be presented with the oral presentation to illustrate the application of the principles reviewed in the paper.
Derived from text
Aircraft Accidents; Impact; Injuries; Prevention; Collisions

19980048999 Biodynamic Research Corp., San Antonio, TX USA
Applications of Physical Analysis and Crash Survivability
Banks, Robert D., Biodynamic Research Corp., USA; Feb. 1998; 4p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

An aircraft accident is always an emotional event that triggers a flurry of activity, particularly if fatalities are involved. Rescuers, damage control crews, search and rescue teams, MEDEVAC teams, and support staff each play a well rehearsed role in activities surrounding the event. Every accident is unique, with its own set of circumstances, surroundings, mysteries and dangers. Initial confusion is always present. But amidst the wreckage, log of events, communication tapes, eye witness accounts, mission briefing, technical manuals, personal interviews and pathology lie important clues that, properly organized and understood, will indicate the cause and the consequences of the accident. The questions confronting an accident investigation board can vary, but usually involve two issues. The first centers on the cause of the accident. Explaining the cause is fundamental to future prevention of similar accidents. The task of making ’sense’ from ’nonsense’ can be awesome. An investigating team is usually confronted with a confused abundance of physical and human evidence, and an organized approach to information collection and analysis is needed to succeed.
Derived from text
Accident Investigation; Aircraft Accidents; Rescue Operations; Emotional Factors; Damage; Prevention

19980049000 Armed Forces Inst. of Pathology, Washington, DC USA
Aviation Pathology
Cogswell, Steven C., Armed Forces Inst. of Pathology, USA; Feb. 1998; 10p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Aircraft crashes are generally predictable in type and frequency. Different types of aircraft have different types of crashes. Similarly, occupant injuries follow generally predictable patterns, and themselves often consist of patterned abrasions and contusions reflecting portions of the aircraft structure. The role of the medical investigator and/or pathologist includes documentation and interpretation of these injuries to determine how the injuries occurred so that they may be minimized or prevented. The pathologist’s documentation and interpretation of injuries, together with manifestations of natural disease processes, provides the core of the Human Factors data for analysis. As few pathologists are familiar with aircraft crash injuries, their interpretation of the injury patterns may be incorrect, which may significantly compromise the investigation.
Derived from text
Aircraft Accidents; Crash Injuries; Pathology; Human Factors Engineering; Aerospace Medicine; Crashes; Injuries

19980049001 Armed Forces Inst. of Pathology, Washington, DC USA
Aviation Pathology Notes
Cogswell, Steven C., Armed Forces Inst. of Pathology, USA; Feb. 1998; 12p; In English; Also announced as 19980048994; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Topics discussed include the following: Aircraft Mishap Investigation; Survivability Analysis; Armed Forces Military Examiner; Injury Analysis; Control Injuries, and Toxicology.
Author
Aerospace Medicine; Aircraft Accidents; Injuries; Pathology; Toxicology; Survival

19980049200
Complexity and its certification in aeronautics
Javaux, D., Liege, Univ., Belgium; De Keyser, V., Liege, Univ., Belgium; 1997, pp. 2120-2124; In English; Copyright; Avail: Aeroplus Dispatch

Amongst the factors that contribute to human errors in man-machine interaction situations is complexity. In comercial aviation in particular, some recent incidents or accidents can be directly related to the inherent complexity of the highly automated systems present on the flight deck. This paper describes some methods for characterizing and measuring the (cognitive) complexity of these situations. Such methods could be used in new innovative procedures for certifying future flight decks.
Author (AIAA)
Commercial Aircraft; Aeronautics; Task Complexity; Decision Making

19980049588

The application of value-driven decision-making in air combat simulation

Lazarus, Earl, Decision Science Applications, Inc., USA; 1997, pp. 2302-2307; In English; Copyright; Avail: Aeroplus Dispatch

The two main components of a constructive air combat simulation are the hardware models and the model of the pilot decision makers. A model of human pilot behavior must be able to capture the primary drivers of air-to-air combat outcomes: surprise, confusion, and cooperation. Such a model must also be able to perform in a highly complex decision space. Traditional approaches using rule bases are hard-pressed to provide the flexibility and maintainability required in such a decision-making environment. Value-driven based decision models, used in air-to-air combat models such as BRAWLER (aircraft) and TRACES (helicopters), are based upon a relatively straightforward paradigm much like the one used implicitly by many chess players. Using this approach, the selection of a course of action consists of: (1) the selection of a set of alternative courses of actions which span the decision space, (2) projection of each alternative into the future, (3) evaluation (scoring) of the future for each alternative using a value function, and (4) selection of the highest scoring alternative. Since the value function is constructed to be sensitive to the many goals of a given decision, it intrinsically performs tradeoffs among conflicting objectives. In addition, the effects of orders from higher level entities in the decision hierarchy are easily implemented by passing weights to the decision-maker which affect the importance of various components of his or her value-scoring function.
Author (AIAA)
Aircraft Pilots; Human Behavior; Decision Making; Air to Air Missiles; Biological Models (Mathematics)

19980049698

Carotid artery dissection presenting as a painless Horner’s syndrome in a pilot - Fit to fly?

Venketasubramanian, N., Tan Tock Seng Hospital, Singapore; Hui, Francis, Tan Tock Seng Hospital, Singapore; Singh, Jarnail, Civil Aviation Authority of Singapore; Lim, Meng-Kin, Civil Aviation Authority of Singapore; Aviation, Space, and Environmental Medicine; Mar. 1998; ISSN 0095-6562; Volume 69, no. 3, pp. 307-310; In English; Copyright; Avail: Aeroplus Dispatch

We describe a case of a middle-aged Caucasian pilot who presented to us with a painless left Horner’s syndrome due to a focal dissection of the infrapetrous portion of the ipsilateral internal carotid artery. He did not suffer symptoms of cerebral ischemia at the time of onset, or during the following two yr. The Horner’s syndrome persisted unchanged throughout follow-up. Serial magnetic resonance angiograms showed some regression of the focal stenosis at 12 months, with no further change over the next 10 months. The literature suggests that the risk of stroke after onset of dissection is usually in the first month, and the risk of recurrence of dissection is about one percent per year after the first year. Our patient was prescribed aspirin 300 mg/d, and certified to fly as or with a copilot commencing one year after onset of his symptoms.
Author (AIAA)
Aircraft Pilots; Arteries; Dissection; Ischemia; Cerebral Ventricles; Physiological Tests

19980050108

Development and evaluation of a cognitive model of human performance in fighter aircraft

Bautsch, Holly S., Logicon Technical Services, Inc., USA; Narayanan, S., Wright State Univ., USA; McNeese, Michael D., USAF, Armstrong Lab., USA; 1997, pp. 2109-2113; In English; Copyright; Avail: Aeroplus Dispatch

As fighter aircraft become more technologically complex, the major tasks of the pilot become cognitively demanding. Models and theories that represent the domain complexity and associated operator activities are useful in human-centered design. This article describes a human performance model of a fighter pilot developed through cognitive task analysis. The analysis was conducted based on empirically driven concept maps and semi-structured interviews with fighter pilots. The resulting model highlights salient decision points, key concepts, information requirements, problems, and problem solutions encountered in mission scenarios in the context of data collected through human-in-the-loop simulations of prototypical fighter aircraft tasks. This paper outlines the cognitive task analysis, model development, and evaluation.
Author (AIAA)
Fighter Aircraft; Aircraft Pilots; Pilot Performance; Biological Models (Mathematics); Cognitive Psychology; Tasks

19980050110

Pilot non-conformance to alerting system commands

Pritchett, Amy R., Georgia Inst. of Technology, Atlanta, USA; 1997, pp. 2125-2130; In English

Contract(s)/Grant(s): NAG2-716; Copyright; Avail: Aeroplus Dispatch

Instances of pilot non-conformance to alerting system commands have been identified in previous studies. Pilot non-conformance changes the final behavior of the system, and therefore may reduce actual performance from that anticipated. Two simulator studies have examined pilot non-conformance, using the task of collision avoidance during closely spaced parallel approaches as a case study. The first study discovered subjects' decisions to alert, and their selected avoidance maneuver, differed from those typically commanded by collision avoidance systems. The second study found that consonance between the display and the alerting system improved subject agreement with automatic alerts. Based on these results, a general discussion of the factors involved in pilot conformance is given, and design guidelines for alerting systems are suggested.

Author (AIAA)

Aircraft Pilots; Biological Models (Mathematics); Collision Avoidance; Aircraft Maneuvers; Commands

19980050111

Using digital information on the shop floor - Requirements from the technician's perspective

Hastings, Philip A., Galaxy Scientific Corp., USA; 1997, pp. 2131-2136; In English; Copyright; Avail: Aeroplus Dispatch

Under grant from the FAA Office of Aviation Medicine, the Galaxy Scientific Corporation conducted task analysis and job aiding research to identify the human factors issues related to communication and information flow in the turbine repair shop at Delta Air Lines. We created prototype software that was designed to support maintenance technicians working in the repair shop environment. The Turbine Repair Automated Control System (TRACS) was constructed to integrate a number of traditionally separate tasks, such as electronic sign-off on work cards, the ordering of parts, and the lookup of information in digital manuals. The current paper discusses the steps involved in designing the prototype and offers recommendations for approaching similar situations.

Author (AIAA)

Aircraft Maintenance; Floors; Digital Techniques; Information Flow; Human Factors Engineering; Turbine Engines

19980050996

Pilot characteristics

Hunter, David R., FAA, USA; Aviation training: Learners, instruction and organization; 1997, pp. 41-53; In English; Copyright; Avail: Aeroplus Dispatch

A large-scale FAA survey of pilots to obtain data to be used in support of research on aeronautical decision making and on designing training that meets pilots' needs is described. Tables are presented on recent and total flight experience, educational level attained, involvement in hazardous events, and attendance at FAA safety seminars.

AIAA

Aircraft Pilots; Pilot Training; Training Analysis; Training Evaluation

19980051218

Life testing of the Vapor Compression Distillation Urine Processor Assembly (VCD/UPA) at the Marshall Space Flight Center

Wieland, Paul, NASA Marshall Space Flight Center, USA; Life Support & Biosphere Science; 1998; ISSN 1069-9422; Volume 5,, no. 1, pp. 23-29; In English; Copyright; Avail: Aeroplus Dispatch

Waste water and urine generated on the International Space Station (ISS) will be processed to recover pure water using vapor compression distillation (VCD). to verify the long-term reliability and performance of the VCD Urine Processor Assembly (UPA), life testing was performed at the Marshall Space Flight Center (MSFC) from January 1993 to April 1996. Two UPAs, the VCD-5 and VCD-5A, were tested for 204 days and 665 days, respectively. The compressor gears and the distillation centrifuge drive belt were found to have operating lives of approximately 4800 h, equivalent to 3.9 years of operation on ISS for a crew of three at an average processing rate of 1.76 kg/h (3.87 lb/h). Precise alignment of the flex-splines of the fluids and purge pump motor drives is essential to avoid premature failure after about 400 h of operation. Results indicate that, with some design and procedural modifications and suitable quality control, the required performance and operational life can be met with the VCD/UPA.

Author (AIAA)

Distillation Equipment; Compressors; Urine; Service Life; Space Station Payloads; Life Support Systems; Waste Treatment

19980051634

Learning for new technologies

Moore, Phillip J., Newcastle, Univ., Australia; Telfer, Ross A., Newcastle, Univ., Australia; Aviation training: Learners, instruction and organization; 1997, pp. 87-96; In English; Copyright; Avail: Aeroplus Dispatch

One of the inevitabilities for pilots in commercial aviation in the 1990s and beyond is that they will need to become competent in the efficient and effective use of a range of ever increasingly complex technologies. In the case of automation of systems, the machinery is allocated functions that would otherwise be assigned to humans. New technologies have emerged, for example, in training with computer-based training and flight motion simulators, on the flight deck (the glass cockpit), and in the very way in which flights are managed, as with the use of datalink. Indeed, it could be argued that for the majority of pilots undergoing conversion training, grappling with 'new' technologies plays a substantial role in both line operations and training. The level of difficulty is commensurate with the novelty of the technology. In this chapter we address the complexities of these issues and provide a glimpse of how experienced pilots tackle the problems of learning about and using new technologies.

Author (AIAA)

Pilot Training; Training Analysis; Training Evaluation; Aircraft Pilots; Flight Training

19980051637

Expertise and cognitive skills development for ab-initio pilots

Wiggins, Mark W., Newcastle, Univ., Australia; Aviation training: Learners, instruction and organization; 1997, pp. 54-66; In English; Copyright; Avail: Aeroplus Dispatch

A framework within which the development of cognitive training systems can occur is provided. The general characteristics of expertise are defined in terms of behavioral, cognitive, and affective elements to provide the basis for an examination of the general characteristics associated with cognitive expertise. From a training perspective, the extent and nature of the cognitive demands associated with a task can be determined through the application of information acquisition strategies including cognitive task analysis. This serves to clarify the training objectives necessary to develop and implement cognitive training strategies in the ab initio training environment and is therefore likely to increase both training efficiency and pilot safety.

AIAA

Pilot Training; Mental Performance; Training Analysis; Training Evaluation; Intelligence; Aircraft Pilots; Flight Training

19980051639

Age and pilot performance

Tsang, Pamela S., Wright State Univ., USA; Aviation training: Learners, instruction and organization; 1997, pp. 21-40; In English; Copyright; Avail: Aeroplus Dispatch

There are three major approaches to assess pilot performance: subjective evaluation of actual flight performance by the instructor or check pilot, quantitative off-line performance measures (e.g., tracking error, degree of deviation from a simulator flight course, reaction time), and accident rate. The present chapter reviews some of the known age effects on cognitive functions such as perception and decision making that have been identified to be essential to piloting. The relationship between pilot age, experience, perfomance, and accident rate is examined.

Author (AIAA)

Age Factor; Pilot Performance; Aircraft Pilots

19980051642

Aviation training: Learners, instruction and organization

1997; In English; ISBN 0-291-39837-5; Copyright; Avail: Aeroplus Dispatch

The present volume on aviation training discusses the roles of learning, instruction, and the organization in aviation training; age and pilot performance; pilot characteristics; and expertise and cognitive skills development for ab initio pilots. Attention is given to line-orientated flight training (LOFT) for facilitators, predicting and enhancing flightdeck performance, production of crew resource management programs, and a systems approach to initial captain training. Other topics addressed include organizational issues in human factor training, airline training for new technology, training and developing the aircrew manager, and the management of change in aviation training.

AIAA

Flight Training; Pilot Training; Aircraft Pilots; Training Analysis; Training Evaluation

19980056202

Addressing the human element in Unmanned Aerial Vehicles

Monson, Conrad B., Boeing Defense & Space Group, USA; Fong, Craig S., Boeing Defense & Space Group, USA; Marsh, Richard A., Boeing Defense & Space Group, USA; Haas, Michael W., USAF, Armstrong Lab., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1032; Copyright; Avail: Aeroplus Dispatch

There is a growing effort by the military to develop and field Unmanned (Uninhabited) Aerial Vehicle (UAV) systems. This growth has been fueled by technology advances as well as the potentially lower costs of unmanned, relative to manned, aircraft systems. to take full advantage of the opportunities afforded by UAVs requires the effective integration of the human into the UAV system. Recognizing this need, the Air Force Armstrong Laboratory is conducting exploratory and advanced research to better understand human systems and technology requirements for current and future UAVs. As part of this work, the Boeing Defense and Space Group collected information from academia, research groups, UAV system developers, and UAV system users. Analyses of the collected information led to sets of research and technology development recommendations for addressing human systems integration needs in such areas as operator interface design, crew selection, training, force structure integration, automation and deployment. This paper describes several of the findings from these analyses.

Author (AIAA)

Pilotless Aircraft; Man Machine Systems; Military Aircraft; Cost Reduction; Operator Performance

19980056204

The impact of information fusion on crew performance

Garner, Karen T., U.S. Navy, Naval Air Warfare Center, USA; Assenmacher, Thomas J., ARINC, Inc., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1034; Copyright; Avail: Aeroplus Dispatch

The desire for information dominance drives data management, sensor management, and pilot aiding needs for next generation military airborne platforms. Information technology advances (sensors, linked networks, communications, and interfaces) impact human operation of complex weapon systems. Until recently, systems designers were of the opinion that ’more is better’, suggesting that, with more data, an operator could achieve and maintain a high level of situation awareness. Legacy ’stovepipe’ avionics systems, often having a unique data path and display, are still common in today’s tactical aircraft. The sheer volume of data available from the multitude of distributed sensors, and other information sources, overtax tactical operators. Intelligent software is needed to rapidly process and transform data into knowledge-based information for use by the crew. R. S. Wurman’s statement, ’The information supply available to us doubles every 5 years’, is certainly applicable to the tactical situation. This paper discusses the impact of information fusion on crew performance and identifies system critical human system design issues to consider during the design and development phases.

Author (AIAA)

Information Systems; Multisensor Fusion; Flight Crews; Flight Management Systems; Aircraft Pilots

19980056205

Functional models of flight automation systems to support design, certification and operation

Vakil, Sanjay S., MIT, USA; Hansman, R. J., MIT, USA; Jan. 1998; In English

Contract(s)/Grant(s): FAA-95-G-017; NAG1-1581; NAG1-1857

Report No.(s): AIAA Paper 98-1035; Copyright; Avail: Aeroplus Dispatch

The incorporation of advanced flight automation systems into modern aircraft has resulted in an increase in errors in interaction with aircraft automation. A prior study identified the lack of a simple consistent model of the automation as a contributing component and found pilots creating their own ad-hoc models of aircraft automation. This work introduces the concept of a Common Conceptual Model (CCM), a representation of the automation articulated at the early design phases which is common to and consistent between pilots, certification officials and design engineers. Functional requirements of such a model by each of the parties are presented. Several candidate structures are discussed. to explore whether a consistent representation will be useful operationally, an experiment was setup to probe the effects of the structure of information on the ability of operators to predict vertical flight path on abstract Flight Management System.

Author (AIAA)

Automatic Flight Control; Support Systems; Aircraft Models; Flight Management Systems; Aircraft Design; Flight Safety

19980057433

Pilot selection in the Norwegian Air Force - A validation and meta-analysis of the test battery

Martinussn, Monica, Tromso, Univ., Norway; Torjussen, Tore; International Journal of Aviation Psychology; 1998; ISSN 1050-8414; Volume 8,, no. 1, pp. 33-45; In English; Copyright; Avail: Aeroplus Dispatch

The purpose of this study was to evaluate the test battery currently used for pilot selection to the Norwegian Air Force. Selection is currently based on a standard battery of 20 different psychological tests as well as on medical tests and on an interview by a licensed psychologist. First, two-factor analyses were conducted to examine the relation between the tests in the battery. Then, a correlation study was conducted to evaluate the predictive validity of the tests against two criteria of pilot performance collected during the basic training period. Finally, a small-scale meta-analysis of previous validation studies in Norway was conducted. The best predictors of success in training, based on the meta-analysis, were Instrument Comprehension, Mechanical Principles, and Aviation Information (mean correlations 0.29, 0.23, and 0.22, respectively).
Author (AIAA)
Aircraft Pilots; Pilot Selection; Military Aircraft; Psychological Tests; Pilot Training

19980057434

Automation bias - Decision making and performance in high-tech cockpits

Moisier, Kathleen L., NASA Ames Research Center, USA; Skitka, Linda J., Illinois, Univ., Chicago; Heers, Susan, NASA Ames Research Center, USA; Burdick, Mark, Illinois, Univ., Chicago; International Journal of Aviation Psychology; 1998; ISSN 1050-8414; Volume 8,, no. 1, pp. 47-63; In English
Contract(s)/Grant(s): NAS2-832; NCC2-798; NCC2-837; Copyright; Avail: Aeroplus Dispatch

Automated aids and decision support tools are rapidly becoming indispensable tools in high-technology cockpits and are assuming increasing control of cognitive flight tasks, such as calculating fuel-efficient routes, navigating, or detecting and diagnosing system malfunctions and abnormalities. This study was designed to investigate automation bias, a recently documented factor in the use of automated aids and decision support systems. The term refers to omission and commission errors resulting from the use of automated cues as a heuristic replacement for vigilant information seeking and processing. Glass-cockpit pilots flew flight scenarios involving automation events or opportunities for automation-related omission and commission errors. Although experimentally manipulated accountability demands did not significantly impact performance, post hoc analyses revealed that those pilots who reported an internalized perception of accountability for their performance and strategies of interaction with the automation were significantly more likely to double-check automated functioning against other cues and less likely to commit errors than those who did not share this perception. Pilots were also likely to erroneously 'remember' the presence of expected cues when describing their decision-making processes.
Author (AIAA)
Cockpits; Decision Making; Technology Utilization; Automatic Flight Control; Cognitive Psychology; Aircraft Pilots

19980058083

Effects of inflight environment multiple factors on the parameters of aircraft oxygen equipment

Xiao, Huajun, Beijing Univ. of Aeronautics and Astronautics, China; Yuan, Xiugan, Beijing Univ. of Aeronautics and Astronautics, China; Beijing University of Aeronautics and Astronautics, Journal; Oct. 1997; ISSN 1001-5965; Volume 23, no. 5, pp. 586-589; In Chinese; Copyright; Avail: Aeroplus Dispatch

The effects of mental stress in high-speed flight tests at low altitudes on pilots' respiratory systems are reported. The results show that though g-load is an important physiological workload in flying work, the pilots' psychological workload at high speed at low altitudes is a more important mental workload which causes significant increases in the pilots' pulmonary ventilation and instantaneous oxygen demand reaching 255 L/min. The results are important in the design and computation of oxygen consumption, carrying volume of oxygen, and the instantaneous oxygen demand of aircraft oxygen-breathing equipment.
Author (AIAA)
Flight Tests; Flight Stress; Oxygen Breathing; Respiratory System; Aircraft Pilots; Mental Performance

19980058090

A comparison of stereopsis with ANVIS and F4949 night vision goggles

Knight, Kenneth K., USAF, School of Aerospace Medicine, USA; Apsey, Douglas A., USAF, School of Aerospace Medicine, USA; Jackson, William G., USAF, School of Aerospace Medicine, USA; Dennis, Richard J., USAF, School of Aerospace Medicine, USA; Aviation, Space, and Environmental Medicine; Feb. 1998; ISSN 0095-6562; Volume 69, no. 2, pp. 99-103; In English; Copyright; Avail: Aeroplus Dispatch

This study was undertaken to see if the model of NVG affects stereoacuity. We tested 13 male and two female aircrew with the Aviator's Night Vision Imaging System (ANVIS) and F4949 NVGs. Visual acuity was measured using the NVG Resolution Grid and stereopsis was determined using a modified Howard-Dolman test. In simulated light conditions, average stereoscopic threshold using the F4949 NVG (17.35 arcsec) was not significantly better than the ANVIS NVG (18.42 arcsec), the mean difference being 1.07 arcsec (95 percent confidence limits, -2.85 to 4.99). The Howard-Dolman test proved to be effective in eliminating

monocular clues, thus validating its use in testing NVG stereopsis. The distribution of visual acuities across subjects and goggle models was too narrow to evaluate the effect of visual acuity on stereoacuity in NVGs. Differences in trial means during the course of the study indicated the presence of a learning effect on the Howard-Dolman test.
Author (AIAA)
Aircraft Pilots; Night Vision; Goggles; Stereoscopic Vision; Nap-Of-The-Earth Navigation; Imaging Techniques

19980058100

Effect of 100 percent oxygen on EKG changes and serum myoglobin in fighter pilots

Comens, Phillip, 131st Tactical Hospital, USA; Aviation, Space, and Environmental Medicine; Feb. 1998; ISSN 0095-6562; Volume 69, no. 2, pp. 149-153; In English; Copyright; Avail: Aeroplus Dispatch

The author previously reported in-flight EKG changes, Pa2, and blood chemistries in F-4 pilots during surface attack training (SAT) and aerial combat maneuvers (ACM) while breathing ambient air. Myoglobin levels were also measured to determine if rhabdomyolysis occurred during positive +Gz force expenditure. Instead of rising, serum myoglobins dropped sharply during 45 min missions. EKGs revealed marked ischemic and arrhythmia changes. This study further evaluates these changes. There were 22 EKG in-flight recordings made on 20 aircrew members breathing 100 percent oxygen during SAT and ACM and compared with previously reported results with pilots using ambient air. In six of those pilots using 100 percent oxygen, serum myoglobin, ACTH, and cortisol levels were determined before and after each mission and also compared with previously reported results obtained on ambient air. of the six aircrew in the blood study, three flew similar missions the following day on ambient air as a control, with a significant decrease in serum myoglobin after each mission. While sinus arrhythmia and tachycardias persisted on 100 percent oxygen, ischemic changes were absent. ACTH and cortisol levels increased similarly in both studies consistent with a stress response. Serum myoglobins remained unchanged on 100 percent oxygen, unlike the marked decrease noted on ambient air.
Author (AIAA)
Aircraft Pilots; Serums; Oxygen; Myoglobin; Electrocardiography

19980058102

Primary idiopathic optic neuritis in U.S. Air Force aviators

Ivan, Douglas J., Aerospace Consultation Service, USA; Tredici, Thomas J., Aerospace Consultation Service, USA; Burroughs, John R., USAF, USA; Pasquale, August, USAF, USA; Hickman, James R., Jr., USAF, USA; Cuervo, Herminio, USAF, USA; Gooch, John, USAF, USA; Aviation, Space, and Environmental Medicine; Feb. 1998; ISSN 0095-6562; Volume 69, no. 2, pp. 158-165; In English; Copyright; Avail: Aeroplus Dispatch

The records of 31 male aviators seen at the Ophthalmology Branch of the USAF Aeromedical Consultation Service for a diagnosis of primary idiopathic optic neuritis (PION) were reviewed. Each subject received comprehensive ophthalmologic and neurologic examinations. The long-term follow-up data were collected through repeat examinations and by survey. Despite 39 percent of aviators being grounded due to complications of their PION or multiple sclerosis (MS), many aviators diagnosed with PION may be safely returned to flying duties. However, any aviator diagnosed with PION has a risk of recurrence or a potential to develop systemic MS and must be carefully reevaluated and followed to ensure they remain a viable asset and do not compromise flight safety or mission completion.
Author (AIAA)
Neuritis; Aircraft Pilots; Visual Acuity

19980058181

EGG and nausea under vestibular stimulus

Tian, Guanqiang, Chinese Air Force, China; Yu, Yaorong, Chinese Air Force, China; Liu, Zhiqiang, Chinese Air Force, China; Bai, Gang, Chinese Air Force, China; Hu, Suwei, Chinese Air Force, China; Gu, Ying, Chinese Air Force, China; Space Medicine & Medical Engineering; Oct. 1997; ISSN 1002-0837; Volume 10, no. 5, pp. 337-339; In Chinese; Copyright; Avail: Aeroplus Dispatch

Eighty-one pilots were exposed to vestibular stimulus with Coriolis acceleration. They were divided into two groups: the first group consisted of 38 pilots with nausea symptoms; the second group consisted of 43 pilots without any nausea symptoms. The dominant frequency instability coefficient (DFIC), dominant power instability coefficient (DPIC), tachygastria, bradygastria, and normal slow wave (NSW) components of the electrogastrogram (EGG) were analyzed. The results showed that the bradygastria and the NSW components of the EGG were related to the nausea symptoms of the pilots under Coriolis stimulation.
Author (AIAA)
Electrophysiology; Vestibular Tests; Nausea; Gastrointestinal System; Coriolis Effect; Motion Sickness; Aircraft Pilots

19980058184

Sphygmographic parameters in fighter and transport pilots

Gai, Yuqing, Inst. of Space Medico-Engineering, China; Tian, Guangqing, Inst. of Space Medico-Engineering, China; Yu, Yaorong, Inst. of Space Medico-Engineering, China; Zhao, Yuanhuai, Inst. of Space Medico-Engineering, China; Liang, Bo, Inst. of Space Medico-Engineering, China; Space Medicine & Medical Engineering; Oct. 1997; ISSN 1002-0837; Volume 10, no. 5, pp. 349-352; In Chinese; Copyright; Avail: Aeroplus Dispatch

To evaluate and discover hidden cardiovascular trouble in pilots, the cardiovascular function of 129 active male pilots was examined with a new sphygmographic method. Thirteen (10.3 percent) of the pilots were found to have abnormal cardiovascular function. The average arterial blood pressure and medium artery modulus of the fighter pilots aged from 30 to 34 years were inferior to those aged from 25 to 29, obviously; however, this was not the case in transport pilots. This indicates that frequent examination of cardiovascular function with this convenient special method is necessary for the improvement of the medical quality monitoring of pilots.

Author (AIAA)

Sphygmography; Fighter Aircraft; Transport Aircraft; Aircraft Pilots; Flight Fitness; Cardiovascular System

19980058363

Managing operational fatigue

Rosekind, Mark, NASA Ames Research Center, USA; Neri, David, NASA Ames Research Center, USA; Dinges, David, Pennsylvania, Univ., Philadelphia; Aerospace International; Jan. 1998; ISSN 0305-0831; Volume 25, no. 1, pp. 28-33. Abridged; In English; Copyright; Avail: Aeroplus Dispatch

The problem of fatigue in the aviation industry is examined in the context of the safety of aviation operations. The discussion focuses on human sleep requirements, Circadian rhythms, fatigue contribution to accidents, and the use of scientific data in operational policies. The need for integrated and comprehensive programs that utilize the available scientific research and a multicomponent approach to managing alertness and enhancing the performance capability on the job is emphasized.

AIAA

Aircraft Accidents; Fatigue (Biology); Sleep; Aircraft Pilots; Alertness; Circadian Rhythms

19980059661

A comparison of cybersickness incidences, symptom profiles, measurement techniques, and suggestions for further research

Kennedy, Robert S., Essex Corp., USA; Lanham, D. S., Essex Corp., USA; Drexler, Julie M., Essex Corp., USA; Massey, Catherine J., Essex Corp., USA; Lilienthal, Michael G., U.S. Naval Medical Research and Development Center, USA; Presence: Teleoperators and Virtual Environments; Dec. 1997; ISSN 1054-7460; Volume 6,, no. 6, pp. 638-644; In English; Copyright; Avail: Aeroplus Dispatch

The widespread use of virtual environment (VE) systems in a variety of applications has serious implications for the user. Users with access to these sophisticated interactive immersions in multisensory 3D synthetic environments have been shown to experience motion sickness-like symptoms (eyestrain, ataxia, fatigue, drowsiness) and aftereffects such as visual flashbacks, disorientation, and balance disturbances occasionally occurring up to 12 hours after VE exposure. This is a significant health and safety concern. Technical improvements of VE systems need to be initiated to reduce these potential aftereffects that could result in adverse legal, economic, individual, and social consequences. Many different types of symptoms have been reported that appear to make up the cybersickness syndrome. From our extensive database of virtual environment and flight simulator exposures, we offer examples of these symptoms profiles along with suspected mechanisms and origins. We discuss these issues as well as various assessment techniques and methods used to determine the presence of VE sickness in individuals.

Author (AIAA)

Virtual Reality; Motion Sickness; Flight Simulators

19980059885

Human-computer cooperation for building controller

Shiraz, G. M., New South Wales, Univ., Australia; 1997, pp. 1039-1044; In English; Copyright; Avail: Aeroplus Dispatch

This paper proposes a new interactive method called Parvaz in which an expert and a learning program cooperate with each other to create a controller for dynamic systems. This method has been demonstrated for the skill of flying an aircraft in a flight simulator. Dynamic Ripple Down Rules have been developed for those parts of the system where it is possible for the pilot to verbalize his or her control strategy. For those parts of the flight where it is difficult or impossible for the pilot to formulate his or her strategy, Learning Dynamic Ripple Down Rules (LDRDR) have been developed to automatically produce rules from the

logged data of the expert's behavior. Parvaz has been tested using three volunteers. All the subjects were successful in creating a set of rules that can fly an aircraft through a given flight plan.
Author (AIAA)
Human-Computer Interface; Control Systems Design; Machine Learning; Expert Systems; Flight Simulators

19980060355

Virtual maintenance - Real-world applications within virtual environments

Abshire, Kevin J., Lockheed Martin Tactical Aircraft Systems, USA; Barron, Mike K., Lockheed Martin Tactical Aircraft Systems, USA; 1998, pp. 132-137; In English; Copyright; Avail: Aeroplus Dispatch

The creation of a virtual maintenance capability within LMTAS has led supportability engineering into the world of virtual reality. Achievements in applying this technology are described. Insight is provided into the challenges met and benefits derived as a result of applying this emerging technology to real-world requirements.
Author (AIAA)
Human Factors Engineering; Maintenance; Virtual Reality; F-16 Aircraft; Computer Aided Design; Biological Models (Mathematics)

19980060446

Specifying training needs in dynamic judgment tasks using a lens model approach

Bisantz, Ann M., Georgia Inst. of Technology, Atlanta, USA; Gay, Paul, Georgia Inst. of Technology, Atlanta; Phipps, Donita A., Georgia Inst. of Technology, Atlanta; Walker, Neff, Georgia Inst. of Technology, Atlanta; Kirlik, Alex, Georgia Inst. of Technology, Atlanta; Fisk, Arthur D., Georgia Inst. of Technology, Atlanta; 1997, pp. 1849-1854; In English
Contract(s)/Grant(s): N61339-95-K-0018; Copyright; Avail: Aeroplus Dispatch

An important aspect of developing training interventions for complex environments is the characterization of individual performance in order to tailor training to the needs of each individual. Individual judgment performance in a command and control environment was modeled as linear combinations of environmental cue values using a lens model approach. Results showed that overall, all participants had accurate knowledge of the environment but that good and poor performers were distinguished by the consistency with which they executed judgment strategies based on this knowledge.
Author (AIAA)
Knowledge; Education; Decision Making; Complex Systems; Aircraft Models

19980060449

SMART Center - A distance training approach for aviation maintenance personnel

Chandler, Terrell N., Galaxy Scientific Corp., USA; Earon, Craig, Galaxy Scientific Corp., USA; 1997, pp. 1873-1877; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes the SMART Center (Safe Maintenance in Aviation Resource Training Center) developed for the FAA Office of Aviation Medicine to teach human factors concepts to aviation maintenance personnel. The intent of this paper is to illustrate possibilities of training through a virtual campus. The issues that one must consider when implementing such a facility are highlighted, as are the advantages of such an approach. During the conference presentation, the SMART Center is demonstrated.
Author (AIAA)
Aircraft Maintenance; Human Factors Engineering; Maintenance Training

19980060450

Supervisory task analysis - Aircraft maintenance environment

Kraus, David C., Galaxy Scientific Corp., USA; Gramopadhye, Anand K., Clemson Univ., USA; Saboda, Richard, Galaxy Scientific Corp., USA; Chandler, Terrell N., Galaxy Scientific Corp., USA; 1997, pp. 1878-1883; In English; Copyright; Avail: Aeroplus Dispatch

A safe and reliable air transportation system depends on a well-designed and operated maintenance system. The linchpin of the maintenance system is the supervisor who is responsible for the maintenance, repair, and delivery of an airworthy aircraft. A task analysis of the supervisory function was conducted to obtain a better understanding of the requirements of this function. For the purposes of this study, two large certified repair station facilities were selected because they provided a broad spectrum of supervisory personalities, protocols, and operational philosophies. In both facilities, the tasks and activities of lead mechanics and foremen were examined. A hierarchical task description/analysis technique was used, and the result was the recommendation

of a leadership skills training curriculum to facilitate the leadership tasks and activities of first- and second-line supervisors within the aircraft maintenance environment.
Author (AIAA)
Aircraft Maintenance; Air Transportation; Maintenance Training

19980060461
Pilot performance with predictive system status information
Trujillo, Anna C., NASA Langley Research Center, USA; 1997, pp. 1972-1977; In English; Copyright; Avail: Aeroplus Dispatch

Research has shown a strong pilot preference for predictive information of aircraft system status in the flight deck. However, the benefits of predictive information have not been quantitatively demonstrated. The study described here attempted to identify and quantify these benefits if they existed. In this simulator experiment, three types of predictive information (none, whether a parameter was changing abnormally, and the time for a parameter to reach an alert range) and four initial times to an alert (1 minute, 5 minutes, 15 minutes, and ETA+45 minutes) were found to affect when subjects accomplished certain actions, such as accessing pertinent checklists, declaring emergencies, diverting, and calling the flight attendant and dispatch.
Author (AIAA)
Pilot Performance; System Failures; Flight Simulators; Flight Safety

19980060463
Designing to control flight crew errors
Schutte, Paul C., NASA Langley Research Center, USA; Willshire, Kelli F., NASA Langley Research Center, USA; 1997, pp. 1978-1983; In English; Copyright; Avail: Aeroplus Dispatch

NASA Langley Research Center has initiated an effort to design a human-centered flight deck without constraints of existing designs. The effort will be based on recent research in human-centered design philosophy and mission management categories. This design will match the human’s model of the mission and function of the aircraft to reduce unnatural or nonintuitive interfaces. The product of this effort will be a flight deck design description, including training and procedures, and a cross reference or paper trail back to design hypotheses, and an evaluation of the design. The present paper discusses the philosophy, process, and status of this design effort.
Author (AIAA)
Flight Crews; Errors; Aircraft Accidents; Human Factors Engineering

19980064705
Decision support for the general aviation pilot
Painter, John H., Texas A & M Univ., College Station, USA; Kelly, Wallace E., III, Texas A & M Univ., College Station; Trang, Jeffrey A., Texas A & M Univ., College Station; Lee, Christopher A., Texas A & M Univ., College Station; Branham, Paul A., Texas A & M Univ., College Station; Crump, John W., Knowledge Based Systems, Inc., USA; Ward, Donald T., Texas A & M Univ., College Station; Krishnamurthy, Karthik, Texas A & M Univ., College Station; Woo, Dick L. Y., Texas A & M Univ., College Station; Alcorn, William P., Texas A & M Univ., College Station; 1997, pp. 88-93; In English; Copyright; Avail: Aeroplus Dispatch

We present an on-board computational system that increases pilot situational awareness, decreases diversion to routine computations, and anticipates upcoming needs. The key to anticipatory flight management is an expert system that uses knowledge of ATC procedures, aircraft operating procedures and limitations, and aircraft performance to infer current flight operating ’mode’ without direct pilot intervention or input. A flight mode interpreter (FMI) enables automatic display selection, pilot advice, and warning. This paper reports the development of an FMI-based flight management system, called General Aviation Pilot Advisory and Training System (GAPATS), that is being developed jointly by Texas A & M University and Knowledge Based Systems, Inc. Software development is carried out using a fixed-base engineering flight simulator. Pilot participation in all phases of development and evaluation is the norm. Flight tests have begun on an instrumented research light twin owned by the Texas A & M University Flight Mechanics Laboratory.
Author (AIAA)
Decision Making; General Aviation Aircraft; Aircraft Pilots; Flight Management Systems

19980064904
User-centered interface design of tactical aircraft displays
Hutchins, Susan G., U.S. Naval Postgraduate School, USA; Hutchins, Robert G., U.S. Naval Postgraduate School, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1036; Copyright; Avail: Aeroplus Dispatch

Tactical aviators must perform under highly complex, dynamic, multitask decisionmaking situations. At any point in time, a number of different tasks may demand attention, and each of these tasks is typically knowledge intensive and procedurally complex. Contact identification alone often involves time-compressed, ambiguous decision problems. The memory and cognitive processing requirements of these tasks often exceed the human's capacity to perform the requisite subtasks. A user-centered design approach was taken with deference to human performance capacities and limitations. Design features include the use of graphics to support intuitive processes and reduce cognitive processing requirements and structuring and presenting information in a format that parallels the decisionmaker's natural cognitive strategies. These decision support display features are directed at improving information sampling, reducing processing complexity, making information conform to human memory and cognitive strategy characteristics, avoiding cognitive overload, and enhancing the speed, coherence, and efficiency with which decisionmakers are able to shift attention and thought between the various tasks that arise. Topics include a discussion of decision support and human-system interaction principles and examples of modules designed to enhance decisionmaking.

Author (AIAA)

Fighter Aircraft; Aircraft Instruments; Display Devices; Graphical User Interface; Decision Support Systems

19980064905

Use of design reference scenarios in a user-centered design process

Folds, Dennis J., Georgia Inst. of Technology, Atlanta, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1039; Copyright; Avail: Aeroplus Dispatch

Human factors analyses include analysis of system requirements at the mission, function, and task levels. The use of detailed design reference scenarios can greatly enhance the usefulness of these analyses and provides a mechanism for linking the three levels of analysis. The scenarios can be used to define and illustrate the scope of mission requirements, and to provide a basis for workload predictions. Users should be involved in developing and validating the scenarios. As the design process continues, the scenarios can be implemented in dynamic mission simulation and in human factors test and evaluation.

Author (AIAA)

Human Factors Engineering; Graphical User Interface; Reference Systems; Operator Performance; Aircraft Design

19980065430

Adaptive simulated pilot

Stroud, Phillip D., Los Alamos National Lab., USA; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 352-354; In English; Copyright; Avail: Aeroplus Dispatch

The present adaptive pilot model for an airborne laser theater missile defense system is constructed with a three-part Darwinian cognitive architecture. It is shown that the implementation of pilot behavior with a parameterized set of rules is an effective way to represent a vast array of alternative behaviors; it can easily be set to mimic the behavior of human operators over a limited time domain.

AIAA

Aircraft Pilots; Aviation Psychology; Cognitive Psychology; Antimissile Defense; Adaptive Control

19980066808

An in-flight investigation of the efficacy of dextroamphetamine for sustaining helicopter pilot performance

Caldwell, John A., Jr., U.S. Army, Aeromedical Research Lab., USA; Caldwell, J. Lynn, U.S. Army, Aeromedical Research Lab., USA; Aviation, Space, and Environmental Medicine; Dec. 1997; ISSN 0095-6562; Volume 68,, no. 12, pp. 1073-1080; In English; Copyright; Avail: Aeroplus Dispatch

A promising countermeasure for fatigue in sustained aviation operations is stimulant administration. However, well-controlled, aviation-relevant studies of the efficacy of medications such as Dexedrine are virtually nonexistent. In this investigation, flight performance, mood, and alertness were evaluated in 10 UH-60 pilots during sleep deprivation periods under Dexedrine or placebo. Relative to placebo, Dexedrine improved flight performance during straight-and-levels, climbs, descents, right turns, and a left-descending turn, with tendencies toward better performance during the left turns and the instrument landing system approach. Dexedrine markedly reduced subjective feelings of fatigue, confusion, and depression while increasing feelings of vigor. Central nervous system arousal was enhanced by Dexedrine relative to placebo. No significant side effects occurred, although Dexedrine was associated with mild asymptomatic increases in heart rate and BP. Thus, Dexedrine appears effective for

the short-term sustainment of aviator performance during sustained operations. However, future work should investigate the efficacy of stimulants for longer-term use (more than 40 h of continuous wakefulness).
Author (AIAA)
Helicopter Control; Pilot Performance; Fatigue (Biology); In-Flight Monitoring; Stimulants; Sleep Deprivation

19980066809

Validity of using non-pilot subjects to represent pilots in a sustained acceleration environment

Popper, Stephen E., USAF, USA; Aviation, Space, and Environmental Medicine; Dec. 1997; ISSN 0095-6562; Volume 68,, no. 12, pp. 1081-1087; In English; Copyright; Avail: Aeroplus Dispatch

A preliminary study determined the similarities between the personality of military pilots (transport and fighter) and centrifuge subjects using the Edwards Personal Preference Schedule. Past similar personality studies have shown differences between fighter and transport pilots, and general population vs male and female general aviators. to use subjects in lieu of pilots in the centrifuge, they must represent the pilot characteristics of interest, for both ethical and scientific reasons. With the increase in measuring performance metrics (e.g., reaction time, tracking tasks, missile evasion) during centrifuge testing, any factor effecting performance must be explored. It is unknown whether personality affects performance. Cluster analysis of 36 pilot and subject personality tests were conducted. The clusters generated by the 36 pilots and subjects did not match the Retzlaff and Gibertini (1987) clusters. Two clusters were preferred over three, and while the values of the personality variables Dominance, Exhibition, and Aggression were similar, the pilot membership did not coincide. Subjects had basically the same cluster characteristics as pilots and did not alter the pilot cluster composition characteristics when clustered together. Females did not appear to differ from the males in the cluster analysis.
Author (AIAA)
Aircraft Pilots; Fighter Aircraft; Personality Tests; Transport Aircraft; Sex Factor; Pilot Performance

19980066810

Stress in Air Force aviators facing the combat environment

Parsa, Brian B., USAF, School of Aerospace Medicine, USA; Kapadia, Asha S., USAF, School of Aerospace Medicine, USA; Aviation, Space, and Environmental Medicine; Dec. 1997; ISSN 0095-6562; Volume 68,, no. 12, pp. 1088-1092; In English; Copyright; Avail: Aeroplus Dispatch

This paper evaluates the effect of stress on four squadrons of USAF aviators in tactical high performance aircraft deployed for combat operations compared with U.S.-based aircrew using the Beck Depression Inventory as the evaluating instrument. This is a retrospective cross-sectional study consisting of 42 aviators in deployed squadrons stationed overseas and involved in a contingency mission, and 15 subjects stationed in the U.S. and not exposed to combat conditions. Each subject was administered the test instrument, which was completed in privacy and with complete anonymity. The hypotheses of interest were: the proportion of individuals in the population of fighter aircrew who would report excessive stress is 0, and no significant differences would exist in the proportion of individuals with excessive stress in the various squadrons. Using statistical methodology, these hypotheses were rejected. It is concluded that more studies in each given circumstance are necessary.
Author (AIAA)
Aircraft Pilots; Stress (Biology); Combat; Fighter Aircraft; Pilot Performance

19980066819

Case report - Obstructive sleep apnea an air safety risk

Panton, S., National Univ. Hospital, Denmark; Norup, P. W., National Univ. Hospital, Denmark; Videbaek, R., National Univ. Hospital, Denmark; Aviation, Space, and Environmental Medicine; Dec. 1997; ISSN 0095-6562; Volume 68,, no. 12, pp. 1139-1143; In English; Copyright; Avail: Aeroplus Dispatch

Aviation safety reports indicate that many incidents are related to fatigue. Obstructive sleep apnea (OSA) is characterized by irregular snoring with repeated apnea episodes during sleep and excessive daytime sleepiness. Deprived of sleep, patients suffer from daytime sleepiness and involuntary sleep attacks. The prevalence of OSA among adult men is more than one percent, 0.5 percent in women. Predisposed are men aged 40-65 yr. Many patients, including pilots, are unaware of their sleeping disturbance and the symptoms are not easily recognized. Therefore, this condition may not be discovered during a regular health examination. However, this condition can be effectively treated. In our opinion, pilots suffering from OSA do not necessarily have to lose their certificate. Diagnosis and treatment can be conducted, followed by regular checkups. We suggest that questions about sleep be included in pilots’ health examinations.
Author (AIAA)
Aircraft Pilots; Flight Safety; Sleep Deprivation; Health

19980067154

Towards the error free cockpit

Courteney, Hazel, Civil Aviation Authority, Safety Regulation Group, UK; Aerospace International; Dec. 1997; ISSN 0305-0831; Volume 24,, no. 12, pp. 24-26; In English; Copyright; Avail: Aeroplus Dispatch

The CAA's Safety Regulation Group has proposed regulatory extensions that will help certification teams to ensure that new or modified flight deck designs meet goals aimed at zero-pilot-errors. Means toward these ends encompass adequate feedback to pilot actions, positive challenges for potentially hazardous actions, and a structured analysis of error effects.

AIAA

Cockpits; Research and Development; Aircraft Design; Flight Safety; Pilot Error; Flight Crews

19980067748

Integrated human centered systems approach to the development of advanced cockpit and air traffic management systems

Hansman, R. J., MIT, USA; Kuchar, James K., MIT, USA; Clarke, John-Paul, MIT, USA; Vakil, Sanjay, MIT, USA; Barhydt, Richard, MIT, USA; Pritchett, Amy, Georgia Inst. of Technology, Atlanta; 1997, pp. 6.3-1 to 6.3-9; In English; Copyright; Avail: Aeroplus Dispatch

Human performance considerations are expected to be central to the performance of advanced cockpit and air traffic management (ATM) systems. The development of information systems and decision aids in these advanced systems will be simultaneously driven by technical and human capabilities coupled with operational requirements. An integrated human centered systems approach is suggested which considers the human controller as a functional component of the closed loop information system. Recent research activities which illustrate different aspects of human performance issues are discussed.

Author (AIAA)

Systems Integration; Man Machine Systems; Cockpits; Human Performance

19980067750

A study of commercial flight crew self-separation

Cashion, Patricia, San Jose State Univ., USA; Macintosh, Margaret-Anne, San Jose State Univ., USA; McGann, Alison, San Jose State Univ., USA; Lozito, Sandra, NASA Ames Research Center, USA; 1997, pp. 6.3-18 to 6.3-25; In English; Copyright; Avail: Aeroplus Dispatch

The concept of 'free flight' is intended to emphasize more flexibility for the operators in NAS by providing more opportunities for aircraft self-separation. The purpose of this simulation was to begin examining some of the communication and procedural issues associated with self-separation in the enroute environment. A simulation demonstration was conducted in the Boeing 747-400 simulator at NASA/Ames. Commercial U.S. pilots current on the B747-400 aircraft were the participants. Ten flight crews flew in the Denver enroute airspace. A new alerting logic designed to allow for airborne self-separation was created for this demonstration. New flight deck display features were designed and incorporated into the existing navigational display in the simulator to allow for increased traffic and maneuvering information to the flight crew. Each of the flight crews flew eight different scenarios representing different conflict types. The effects of traffic density (high and low) and the introduction of an 'almost intruder' (AI) aircraft were assessed. Loss of separation was assessed as a safety metric. Timing variables and maneuver strategies were examined to determine potential differences in efficiency of navigation in free flight based on scenario and conflict type. The impact of these findings on free flight procedural definitions are discussed.

Author (AIAA)

Free Flight; National Airspace System; Flight Crews; Flight Simulators; Boeing 777 Aircraft; Aircraft Approach Spacing

19980067751

Experimental study of helmet-mounted display attitude and flow cues on rotorcraft hover performance

Bachelder, E. N., MIT, USA; Hansman, R. J., Jr., MIT, USA; 1997, pp. 6.3-26 to 6.3-32; In English; Copyright; Avail: Aeroplus Dispatch

A study was conducted to investigate the use of visual flow and attitude cues as an aid to lateral drift awareness during helicopter flight while using night vision goggles (NVGs). Four displays were compared: NVG display: the baseline display simulating an NVG image of the cockpit and external environment; NVG/attitude display: NVG image with an overlay of an attitude symbol and a surrounding Earth-referenced wire-frame globe; rate display: NVG image with an overlay of a flow cue field; and rate/attitude display: NVG image with the rate and NVG/attitude display overlays. The task objective was to null out lateral rates in the presence of lateral gusts while in a hover. This task was conducted in a fixed-based helicopter simulator using a helmet-mounted virtual reality device. Three pilots were used in this preliminary study. The mean rms drift rate error associated with the baseline NVG display was approximately 6 ft/s. The introduction of rate cues reduced this error by a factor of three. Mean rms position

error using the NVG display was 90 feet, which was decreased by an order of magnitude when rate cues were overlaid on the NVG image. The addition of attitude in the rate/attitude display substantially improved lateral rate control stability where gain margin for the rate display had degraded.
Author (AIAA)
Helmet Mounted Displays; Hovering

19980067752

Crew interfaces for future ATM

Huisman, H., National Aerospace Lab., Netherlands; Verhoeven, R. P. M., National Aerospace Lab., Netherlands; van Houten, Y. A., National Aerospace Lab., Netherlands; Flohr, E. R., National Aerospace Lab., Netherlands; 1997, pp. 6.3-33 to 6.3-40; In English; Copyright; Avail: Aeroplus Dispatch

Two flight simulator evaluations were conducted at NLR with a 4-DOF moving base simulator. A navigation display (ND) and a primary flight display (PFD) for application in a future air traffic management environment were evaluated. A total of 22 airline pilots participated. It is concluded that flight execution by using a perspective PFD resulted in more accurate flight performance, faster recovery after the occurrence of an aircraft failure, and less visual workload. Interactive graphical user interfaces for flight planning and monitoring based on the ND are well accepted by pilots.
Author (AIAA)
Flight Simulators; Display Devices; Flight Management Systems

19980067790

Pilot non-conformance to altering system commands during closely spaced parallel approaches

Pritchett, Amy R., Georgia Inst. of Technology, Atlanta, USA; Hansman, R. J., MIT, USA; 1997, pp. 9.1-1 to 9.1-8; In English Contract(s)/Grant(s): NAG2-716; Copyright; Avail: Aeroplus Dispatch

Pilot nonconformance to alerting system commands has been noted in general and to a TCAS-like collision avoidance system in a previous experiment. This paper details two experiments studying collision avoidance during closely-spaced parallel approaches in instrument meteorological conditions, and specifically examining possible causal factors of, and design solutions to, pilot nonconformance.
Author (AIAA)
Collision Avoidance; Aircraft Approach Spacing; Flight Simulators

19980068284

Flight technology and the human factor ***Flugtechnik und Faktor Mensch***

DLR-Nachrichten; Nov. 1997; ISSN 0937-0420, no. 87, pp. 14-19; In German; Copyright; Avail: Aeroplus Dispatch

Computerized simulations, wind tunnel tests, and flight tests being conducted on helicopters and fixed-wing aircraft at the Institute for Flight Mechanics at Braunschweig are examined. Special attention is given to the interface between man and machine.
AIAA
X-31 Aircraft; Man Machine Systems; Human Factors Engineering; Computerized Simulation; Helicopters; Wind Tunnel Tests

19980068738

The application of the avionics to the lifesaving system

Shen, Weizhong, Air Force, First Aeronautical Inst., China; Xu, Guoqiang, Air Force, First Aeronautical Inst., China; Cha, Guoyun, Air Force, First Aeronautical Inst., China; Zen, Zhenhua, Air Force, First Aeronautical Inst., China; 1997, pp. 463-469; In English; Copyright; Avail: Aeroplus Dispatch

The role of avionics in the development of lifesaving systems aboard aircraft is discussed. The role of avionics in danger estimation, propulsive force control, and flight control in lifesaving systems is addressed. Data processing in an avionics lifesaving system is discussed.
AIAA
Avionics; Aircraft Survivability; Aircraft Control; Electronic Control; Flight Control

19980069543

Man and altitude in aeronautics ***L'homme et l'altitude en aeronautique***

Marotte, Henri, Centre d'Essais en Vol, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Sep. 1997; ISSN 1247-5793, no. 4, pp. 28-35; In French; Copyright; Avail: Aeroplus Dispatch

With increasing altitude, the partial pressure of oxygen in inspired air diminishes. This diminishment is the origin of the state of hypoxia or of acute hypoxia, characterized by central nervous system disturbances. Above 6000 m, the ’critical zone’, is the zone of very acute hypoxia, characterized by the risk of a brief loss of consciousness. In particular, it is the risk incurred in the case of a breakdown in the oxygen system or during decompression accidents in the cabin at high altitude. Cabin decompression brings about perturbations in gas exchange and in breathing mechanics. These phenomena are discussed in this paper.
AIAA
Aeronautics; High Altitude; Hypoxia; Unconsciousness; Decompression Sickness; Central Nervous System

19980069544
Pilots’ G-tolerance
Balldin, Ulf I., National Defence Research Establishment, Sweden; Nouvelle Revue d’Aeronautique et d’Astronautique; Sep. 1997; ISSN 1247-5793, no. 4, pp. 36-39; In English; Copyright; Avail: Aeroplus Dispatch

The high accelerations to which fighter aircraft pilots are subjected cause a pooling of blood and a substantial increase of blood pressure in the lower parts of the body. This may induce visual loss and reduce pilot performance. It may also generate the risk of sudden G-induced loss of consciousness during flight maneuvers. Different techniques have been developed to increase the G-protection of the pilots. These techniques may enhance the G-tolerance and prolong the G-endurance.
Author (AIAA)
Acceleration Tolerance; Fighter Aircraft; Aircraft Pilots; Physiological Responses

19980069545
Disorientation
Money, Kenneth, Civil Inst. of Environmental Medicine, Canada; Nouvelle Revue d’Aeronautique et d’Astronautique; Sep. 1997; ISSN 1247-5793, no. 4, pp. 40-44; In English; Copyright; Avail: Aeroplus Dispatch

Spatial disorientation is defined, and four specific examples are described. The basic cause of disorientation and the source of knowledge about it are examined. Attention is then given to certain mechanisms whereby accelerations and alcohol can produce disorientation. Finally, some comments are made on instruction for pilots dealing with disorientation.
AIAA
Aircraft Pilots; Disorientation

19980069925
F-22 ECS/TMS qualification test program overview
Sprouse, Jim, Lockheed Martin Aeronautical Systems Co., USA; Jul. 1997; In English
Report No.(s): SAE Paper 972261; Copyright; Avail: Aeroplus Dispatch

Qualification testing is performed to verify that component and system designs will operate successfully in their intended environment. The F-22 ECS/TMS is currently well into its component and system qualification testing. This paper addresses a summary of the test program efforts to date, focusing on lessons learned generally applicable to any product development effort. Specific areas to be discussed include: an overview of the system functions and components; a summary of the qualification test program goals and structure at component and system level; discussion of the basic test environments required; importance of a good closed loop failure reporting and corrective action system (FRACAS); key elements of an effective test program; summary of test failures experienced to date, with corresponding corrective actions/lessons learned; and an overview of system and flight qualification tests yet to be performed.
Author (AIAA)
F-22 Aircraft; Environmental Control; Aircraft Reliability

19980070285
Analysing pilot error
Howard, Ron, UK; Aerospace International; Oct. 1997; ISSN 0305-0831; Volume 24,, no. 10, pp. 28-30; In English; Copyright; Avail: Aeroplus Dispatch

An evaluation is conducted of the possibility that air transport safety requirements have outstripped human flight deck-management capabilities, or that, alternatively, the traditional reliability-with-redundancy means of achieving high safety levels are not being satisfactorily applied. It is noted that investigations frequently put more weight on the discovery of an accident’s prime causes than why they were not prevented by provisions already incorporated.
AIAA
Flight Safety; Mtbf; Pilot Error; Error Analysis

19980070807

SAFE Association, Annual Symposium, 35th, Phoenix, AZ, Sept. 8-10, 1997, Proceedings

1997; In English; Copyright; Avail: Aeroplus Dispatch

The present conference discusses B-2 aircrew seat cushion development, potential brain pathologies from repeated +Gz exposure, safe disposal of energetic materials, the features of the 16SL high performance ejection seat, inflatable aerostabilizers for ejection seats, laser-initiated ordnance systems for crew escape, a spinal-related criterion for ejection-seat design, helmet-mounted display stability during +Gz exposure, force-dependent parachute inflation control, and anthropometry in naval aviation. Also discussed are the modeling of human neck response to vertical impact, rocket motor quality assessment for aircrew escape applications, anthropometric accommodation in training aircraft, occupant safety simulations for interior design, a virtual horizon altitude warning system, extended exposure capability after rapid decompression at 60,000 ft altitude, oxygen mask construction using CAD/CAM, and a mishap data evaluation for naval aircraft in the 1987-1996 period.

AIAA

Conferences; Aerospace Safety; Flight Safety

19980070811

Potential pathological effects of repeated +Gz exposures on brain

Sun, Xi-Qing, Fourth Military Medical Univ., China; Zhang, Li-Fan, Fourth Military Medical Univ., China; Wu, Xing-Yu, Fourth Military Medical Univ., China; 1997, pp. 33-38; In English; Copyright; Avail: Aeroplus Dispatch

It has been demonstrated that during +Gz exposure cerebral blood flow is significantly reduced, resulting in brain ischemia. Such conditions could be repeated several times during combat maneuvers. We know little about pathophysiological effects of repeated +Gz exposures on the brain. The present study was undertaken to investigate whether repeated +10 Gz (3 min each) exposures produce brain tissue damage, and whether this is reversible. Awake rats were restrained and placed on animal centrifuge. Control rats were exposed to +1 Gz and an experimental group was exposed to +10 Gz three times each, for 3 min at 30 min intervals. The changes in morphology of cortex were examined immediately, at 1, 6, and 24 h after three +Gz exposures. Light microscopic observations showed that a few neurons in the parietal cortex after repeated +Gz exposures demonstrated ischemic cell changes which returned to normal 24 h after three +Gz exposures. Electron microscope observations showed that, after three +Gz exposures, swollen mitochondria with cristae blurred were observed in a few pyramidal cells. A few pyramidal cells showed degenerative changes with decreased endoplasmic reticulum and ribase nuclear protein and increased lysosomes.

Author (AIAA)

Brain Circulation; Blood Flow; High Gravity Environments; Ischemia; Aircraft Pilots; Physiological Acceleration

19980070812

The effects of heat stress on UH-60 helicopter pilots

Reardon, Matthew J., U.S. Army, Aeromedical Research Lab., USA; Katz, Lawrence C., U.S. Army, Aeromedical Research Lab., USA; Fraser, Beth, U.S. Army, Aeromedical Research Lab., USA; 1997, pp. 39-45; In English; Copyright; Avail: Aeroplus Dispatch

A repeated measures study with 14 aviators flying simulated UH-60 helicopter mission profiles was recently performed to evaluate the effects of standard (MOPPO) and encumbered (MOPP4) aviator ensembles in cool (70 F) and hot (100 F) conditions. Average crew endurance was reduced from the fully completed mission time of 309 minutes in the standard-cool condition to 107 minutes in the encumbered hot condition. This was due to rapid increases in core temperature, progressive physical discomfort and psychological stress, and adversely affected mood. Calculated total body heat storage for the encumbered-hot condition was 1445 W compared to 627 W for the standard-hot condition. Heavy sweat rates while in the encumbered-hot condition led to significantly greater amounts of dehydration over shorter periods of time. The results of this evaluation suggest that encumbered protective aviator flight uniforms should be designed to be lightweight and porous, to allow efficient evaporation of sweat. Microclimate cooling should be considered for preventing excessive core temperature elevation when aviators wear occlusive protective ensembles in hot weather conditions.

Author (AIAA)

Aircraft Pilots; High Temperature Environments; Stress (Physiology); Body Temperature; Dehydration; Protective Clothing

19980070813

Report on the Optimized Mach Number Immune sequencer

Peck, Walter R., LME, Inc., USA; 1997, pp. 46-53; In English; Copyright; Avail: Aeroplus Dispatch

The Optimized Mach Number Immune (OMNI) sequencer has several unique features which have been investigated using pitot pressures and base/beam pressures recorded during several ejection seat flight and track tests. The OMNI sequencer provides

optimum timing of parachute deployment for all airspeeds, for all ejectee weights, and for all ambient temperatures at any altitude and Mach number, based upon actual recovery parachute system test data. It also provides protection against blockage of either or both of the Pitot tubes. It can be tied into the host aircraft air data computer via the 1553 data bus for an automatic ejection signal, for a low or moderate ejection risk signal, and for a Mach number signal to back up the Mach number sensing of the sequencer. A test prototype unit has been built that is suitable for testing in flight or in track-ejection seat tests.
Author (AIAA)
Immune Systems; Aircraft Pilots; Ejection Seats; Recovery Parachutes; Mach Number

19980070822
Establishing a spinal injury criterion for military seats
Rapaport, Martin, U.S. Navy, Naval Air Warfare Center, USA; Forster, Estrella, U.S. Navy, Naval Air Warfare Center, USA; Schoenbeck, Ann, U.S. Navy, Naval Air Warfare Center, USA; Domzalski, Leon, ARCCA, Inc., USA; 1997, pp. 156-164; In English; Copyright; Avail: Aeroplus Dispatch

Currently, military specifications require use of an acceleration-time criterion to assess the physiological acceptability of crash resistant seats and restraint systems. With the evolution of crash test dummies which now exhibit greater biofidelic performance, military researchers are considering 'direct force' measurements taken within the Hybrid III anthropomorphic test device as an alternative evaluation criterion. The FAA recently established such a criterion as part of a new dynamic test requirement for the certification of airline passenger seats. Prior to military triservice implementation of a similar requirement, validation of the methodolgy with the 'aerospace' model of the Hybrid III manikin was necessary. This paper describes the test program conducted with Hybrid III crash test dummies to establish a lumbar spinal load injury criterion for military crash resistant seat compliance testing. Dynamic testing was conducted on the Horizontal Accelerator Facility at the Naval Air Warfare Center. Sufficient data was acquired to conduct a statistical analysis of the Hybrid III's lumbar spine response to compressive loading (i.e., +Gz headward direction). The analysis supports the recommendation to employ lumbar force as a primary physiological criterion for military crash resistant seat compliance.
Author (AIAA)
Spinal Cord; Ejection Injuries; Ejection Seats; Military Technology; Crash Injuries; Test Facilities

19980070825
The effect of helmet inertial properties on male and female head response +Gz impact accelerations
Perry, Chris E., USAF, Armstrong Lab., USA; 1997, pp. 189-195; In English; Copyright; Avail: Aeroplus Dispatch

As women become increasingly integrated into USAF combat missions, there is a potential to see an increase in the number of emergency ejections with females. Current risk assessment methods are based on primarily male data; the need exists to investigate the injury potential of female crewmembers during cockpit ejection. These injuries can be extremely debilitating and even fatal. Additional concern is focused on the effect the catapult phase of ejection will have on aircrew while wearing some form of a helmet-mounted system (HMS). The potential for neck injury may increase due to the increase in dynamic forces generated in the cervical spine as a result of the change in helmet inertial properties including weight, center-of-gravity, and moment-of-inertia. Since women are generally smaller and shorter with different neck strength than males, there may be differences in their degree of susceptibility to neck injury; females have less neck flexor and extensor strength when compared to males. Therefore, the dynamic loads induced in the neck of females with HMS may put them at greater risk during the catapult phase of ejection.
Author (AIAA)
Impact Acceleration; Helmet Mounted Displays; Ejection Injuries; Flight Crews; Center of Gravity; Moments of Inertia

19980070828
Helmet mounted display stability during +Gz exposure
Maoz, Tal, Elbit Systems, Ltd., Israel; 1997, pp. 220-227; In English; Copyright; Avail: Aeroplus Dispatch

The Display and Sight Helmet (DASH) achieves improved stability in the high +Gz environment by means of a well balanced helmet and a tight personal fit to the pilot's head. Several types of personal fit liners and retention straps are being used in the DASH to provide the required fit. The DASH stability during +Gz exposure was successfully verified in a centrifuge. Test subjects wearing several configurations of the DASH with and without Pressure Breathing for G schedule, were exposed to moderate and high +Gz levels, up to +9Gz, and evaluated the comfort and stability of the DASH. Objective as well as subjective data was collected about the helmet comfort and stability. The data collected and the conclusions will be implemented in ongoing programs as well

as in future helmet mounted display activities. This article details the procedures, results and conclusions of the DASH centrifuge evaluation.
Author (AIAA)
Helmet Mounted Displays; Systems Stability; High Gravity Environments; Aircraft Pilots; Human Centrifuges; Eye (Anatomy)

19980070834

Development of an integrated ejection seat/crewmember model

Ma, Deren, Systems Research Labs., USA; Rizer, Annette L., Systems Research Labs., USA; Obergefell, Louise A., USAF, USA; Rogers, Lawrence C., USAF, USA; 1997, pp. 284-292; In English; Copyright; Avail: Aeroplus Dispatch

Ejection seat dynamic characteristics are essential concerns for evaluating ejection systems. Because the crewmember's weight is the same order of magnitude as the ejection seat, his dynamic response during ejection directly affects performance. to assess the ejection seat/crewmember system, an ejection seat model has been coupled with an occupant model, the Articulated Total Body (ATB) model. The integrated ejection seat/crewmember model consists of four modules. The seat module determines the seat motion based on seat inertial properties, and forces and moments acting on the seat. The ATB crewmember module calculates the crewmember biodynamic responses based on the seat motion, body segment physical properties, contact properties, and restraint system. An interface module coordinates the data transfer between the two modules. The seat motion is transferred to the crewmember module that uses it for calculating the crewmember's biodynamics. Meanwhile, the forces and moments acting on the seat by the crewmember and restraint system are sent to the seat module and used to determine seat dynamics. An output module provides simulation results. The model successfully predicts the major features of the ejection seat motion and the crewmember biodynamic responses.
Author (AIAA)
Ejection Seats; Systems Integration; Flight Crews; Biological Models (Mathematics); Ejection Injuries; Biodynamics

19980070835

Data to design - Anthropometry in naval aviation

Tucker, Heather D., U.S. Navy, Naval Air Warfare Center, USA; Todd, Wendy L., U.S. Navy, Naval Air Warfare Center, USA; Kennedy, Greg, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 304-310; In English; Copyright; Avail: Aeroplus Dispatch

The design of many aircrew systems depends on anthropometry, or the measurement of the human body's dimensions; inefficient traditional methods are being replaced by newer methods including multivariate statistical database derivation and digital measuring technologies. These data can be manipulated by various computer software applications to study, model, design, and prototype what naval aviators wear, and digitally quantify their accommodation within a crewstation. This paper discusses two new, statistically derived, anthropometric databases and their application in the reengineering design of naval aircraft crewstations and aircrew life support systems (ALSS); cockpit accommodation modeling and analysis using the CAD based, FaroArm portable coordinate measuring machine; ALSS design, sizing, and prototyping using whole body-scanning technology with CAD/CAM applications; and the potential for design integration of what the pilot wears with the crewstation in which he wears it.
Author (AIAA)
Flight Crews; Anthropometry; Human Body; Biological Models (Mathematics); Cockpits; Computer Aided Design

19980070842

Evaluation of GEBOD as a predictor of human body data - Performed using high resolution human body topography

Whitestone, Jennifer J., USAF, Armstrong Lab., USA; Hudson, Jeffrey A., Sytronics, Inc., USA; 1997, pp. 362-372; In English; Copyright; Avail: Aeroplus Dispatch

Modeling efforts in Armstrong Laboratory are supported by a number of human body data collection programs including horizontal and vertical sled testing, anthropometric studies, reach capability mapping, and strength studies. GEBOD (GEnerator of BOdy Data), a preprocessor for human models including the Articulated Total Body (ATB), generates human body data sets. Seventy subjects (35 men and 35 women) meeting USAF entrance requirements, were measured extensively with traditional anthropometric tools (calipers and tape measures) in a combined effort with the Navy and Armstrong Laboratory to measure whole body mass properties for ejection seats. These measurements are compared to GEBOD predicted measures. Additionally, high resolution 3D surface data of 53 of these subjects was recorded. These image data are compared to the GEBOD-generated output ellipsoidal representations of the subjects. Evaluation of GEBOD as a predictor of human body models is documented. While some of the traditional anthropometric measures showed strong prediction ability by GEBOD, most of them were biased with

either consistently high or low estimates and/or were characterized by distributions greatly skewed to the y = x perfect predictor function.
Author (AIAA)
Human Body; Anthropometry; Ejection Seats; Body Weight; Size (Dimensions); Prediction Analysis Techniques

19980070843

Anthropometric accommodation in training aircraft

Zehner, Gregory, USAF, Armstrong Lab., USA; Hudson, Jeffrey A., Sytronics, Inc., USA; Ivey, Larry, USAF, Aeronautical Systems Center, USA; Anderson, Jenny, USAF, Air Education and Training Command, USA; Kennedy, Kenneth; 1997, pp. 373-379; In English; Copyright; Avail: Aeroplus Dispatch

With the procurement of the Joint Primary Aircraft Training System (JPATS) and its eventual introduction into the USAF and USN inventories, it will be possible to train pilots whose body sizes are considerably smaller than ever before. The USAF is now considering expanding the body size entrance requirements for Undergraduate Pilot Training (UPT) (AFI 48-123) in order to take advantage of the increased accommodation offered by the JPATS aircraft and to provide equal access to flight training for both male and female pilot candidates. During the procurement process for new aircraft, measurements are taken to determine if an aircraft meets the specifications set by the USAF. Measurements are not taken, however, to determine the absolute limits of body size accommodation. We have started a research project to quantify the smallest and largest people that can safely and efficiently operate all types of USAF aircraft now in use. Only preliminary data on training aircraft are available at this time. The user command must define operational requirements, which determine pass/fail criteria for being safely accommodated in the aircraft.
Author (AIAA)
Anthropometry; Training Aircraft; Pilot Training; Flight Training; Size Determination; Cockpits

19980070844

NACES drogue parachute service life-extension evaluation program

Hunter, Richard W., U.S. Navy, Weapons Div., USA; 1997, pp. 380-389; In English; Copyright; Avail: Aeroplus Dispatch

The current need is to reduce life-cycle and maintenance costs of naval equipment without compromising its reliability. The latter is particularly true for emergency egress equipment, such as parachutes where failure is life-threatening. The NACES drogue parachute is pressure-packed in a sealed container that shelters it from the environment. Reducing the life-cycle costs of the parachute by extending its service life should be a minimum risk effort. For this reason, a program was performed to evaluate the feasibility of extending the parachute’s service life. Evaluation of the data indicated that the service life of the packed parachute could be safely extended from 6-8 years. The serial number of the container and the serial number of the parachute are not related. The service life of the container is not controlled, and the user cannot determine the parachute serial number without unpacking the parachute. The results show an excessive amount of data scatter between testing facilities. This scatter results from the variety of test methods used and the inherent variable nature of textile materials.
Author (AIAA)
Flight Crews; Ejection Seats; Life Cycle Costs; Parachutes; Test Facilities; Fracture Strength

19980070846

Virtual horizon altitude warning system

Stevens, David E., Arnold Engineering Development Center, USA; 1997, pp. 405-416; In English; Copyright; Avail: Aeroplus Dispatch

Controlled flight into ground, particularly during reduced visibility, continues despite sophisticated displays and ground proximity warning devices; this could be because the pilot is not aware of the warning, not aware of its urgency, or has insufficient time to react. Current warnings must be visually or aurally detected, perceived and then cognitively interpreted. If the warning is not sufficiently compelling, it may be heard or seen but not perceived. Even if the warning is perceived, it may come too late. The Virtual Horizon Altitude Warning System concept uses the projection of a virtual horizon in the cockpit. This artificial horizon is superimposed over the position of the actual horizon. In addition to the pitch and roll display capability of the virtual horizon, a representation of elevation is added. During poor visibility or darkness, the elevation and rate of movement of the virtual horizon parallels that of the real horizon, subconsciously providing the pilot with descent rate and ground proximity cues. In extremis, the rate of elevation of the virtual horizon can be exaggerated to trigger a reflexive ground rush reaction in the pilot as a reflexive warning.
Author (AIAA)
Aircraft Accidents; Horizontal Orientation; Disorientation; Space Perception; Flight Control

19980070847

Helicopter Aircrew Underwater Breathing Device SRU-40/P

Gierbolini, Luis A., U.S. Navy, Naval Air Warfare Center, USA; Wensel, Janice, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 417-424; In English; Copyright; Avail: Aeroplus Dispatch

The Helicopter Aircrew Underwater Breathing Device, SRU-40/P, is a compact, lightweight breathing assembly designed for emergency use by helicopter, E-2 and C-2 aircrew in the event of a crash landing in water ('ditching'). The SRU-40/P provides emergency breathing air on demand to aid in a safe egress from a submerged aircraft. The device provides 1-3 min of breathing air depending upon the depth underwater, water temperature, and the individual using the device. The SRU-40/P is commonly known as the Helicopter Emergency Egress Device. A general illustration of the SRU-40/P mounted on a SV-2 is provided. The SRU-40/P will be replacing a similar device, the SRU-36/P, which has been operational in the USN since 1986 and was the first such system introduced into the Navy helicopter community.

Author (AIAA)

Flight Crews; Helicopters; Underwater Breathing Apparatus; Emergencies; Crash Landing; Performance Tests

19980070848

Impact of recent altitude physiology research on design of cockpit pressurization systems

Webb, James T., Krug Life Sciences, Inc., USA; Pilmanis, Andrew A., USAF, Armstrong Lab., USA; 1997, pp. 425-430; In English

Contract(s)/Grant(s): F33615-92-C-0018; Copyright; Avail: Aeroplus Dispatch

The U-2 exposes the pilot to a cockpit altitude of approximately 30,000 ft with a 3.8 psid pressurization system. Approximately 70 percent of U-2 pilots reported that decompression sickness (DCS) occurred during their nine-hour missions at this altitude. Design of the F-22 pressurization system was based on previous fighter aircraft systems which maintain 5.0 psi differential pressure above 23,000 ft. Unfortunately, the 60,000 ft planned cruise capability of the F-22 places the pilot at 22,500 ft. The recently-reported threshold for DCS while breathing 100 percent oxygen is approximately 21,000 ft. The threshold altitude implies a need for greater cockpit differential pressure for the F-22 and reinforces the need for breathing 100 percent oxygen prior to and including the high altitude portions of the flight profile. Increasing the cockpit differential pressure to keep the pilot at less than 21,000 ft would eliminate the vast majority of DCS cases. Breathing 100 percent oxygen during this period would provide additional protection from hypoxia in the event of unexpected rapid decompression. Another recent finding indicates that denitrogenation by breathing 100 percent oxygen at altitudes up to 16,000 ft is as effective as ground-level prebreathing. In addition, gas emboli formation at 16,000 ft is lower than at higher altitudes.

Author (AIAA)

Flight Altitude; Cockpits; Pressurized Cabins; Structural Design; Aircraft Pilots; Physiological Responses

19980070849

Extended exposure capability after rapid decompression at 60,000 feet and above

Self, Brian P., USAF, Armstrong Lab., USA; Pilmanis, Andrew A., USAF, Armstrong Lab., USA; Diesel, Donald, USAF, Armstrong Lab., USA; Sears, William J., Aerospace Associates, Inc., USA; 1997, pp. 431-436; In English; Copyright; Avail: Aeroplus Dispatch

There are several offensive and defensive benefits for fighter aircraft to fly at altitudes of 60,000 ft and above. The kinematic range of air-to-air missiles is much greater in high-to-low shots, and high flying aircraft are less likely to be detected by surface threats. Fighter aircraft technology has increased to allow flight above 60,000 ft; similar advances in life support equipment must now be made. The physiologic limitations of hypoxia and decompression sickness at 60,000 ft and above have debilitating consequences. At these altitudes, pressure breathing at the required 70 mmHg cannot be sustained beyond a 'get-me-down' scenario. The Sustained High Altitude Respiratory Protection and Enhanced Design G-Ensemble is being developed to enable the pilot to remain at 60,000 ft and above and complete the mission after an unexpected rapid decompression. The system, which will be compatible with current anti-G suits, will consist of a fully enclosed pressure helmet with neck seal, pressure sleeves added to the vest, and gloves. The helmet design incorporates a pressure breathing mask to provide +Gz protection and an unpressurized crown area to prevent helmet rise.

Author (AIAA)

Fighter Aircraft; Aircraft Pilots; Decompression Sickness; High Altitude Breathing; Physiological Responses

19980070852

A comparison of human and ejection seat test manikin static centers of gravity and moments of inertia

Albery, Christopher B., Systems Research Labs., USA; Bjorn, Valerie S., U.S. Naval Air Warfare Center Liaison, USA; Schultz, Rebecca B., USAF, Armstrong Lab., USA; 1997, pp. 452-464; In English; Copyright; Avail: Aeroplus Dispatch

Regardless of specific design differences, all manikins used for ejection seat testing mimic humans in ejection seats. We compare one key characteristic between manikins and humans, the static mass properties. to do this, a broad selection of ejection seat test manikins (from the 1960s through today) was measured for Centers of Gravity (CG), Mass Moments of Inertia (MOI), and weight. In the measurement procedure, each manikin was seated and secured in an orthogonal, light alloy chair. The CG and MOIs were measured about the three cardinal axes (x, y, and z), and MOIs were also measured about the three noncardinal axes (xy, yz, and xz). The properties of the chair were subtracted to determine each manikin's mass properties alone in a seated position. These manikin data were then plotted against human data collected using identical methods. The human data were collected previously on 35 males and 34 females representing the anthropometric range of future Navy and Air Force pilots. Results indicated manikins are good approximations of their human counterparts, but manikin users are cautioned against altering manikin mass properties with ballasts without consideration of human segmental and whole-body mass properties data.
Author (AIAA)

Ejection Seats; Dummies; Center of Gravity; Moments of Inertia; Anthropometry; Body Weight

19980071842

Aircraft type and diagnosed back disorders in U.S. Navy pilots and aircrew

Simon-Arndt, C. M., U.S. Navy, Naval Health Research Center, USA; Yuan, H., U.S. Navy, Naval Health Research Center, USA; Hourani, L. L., U.S. Navy, Naval Health Research Center, USA; Aviation, Space, and Environmental Medicine; Nov. 1997; ISSN 0095-6562; Volume 68,, no. 11, pp. 1012-1018; In English; Copyright; Avail: Aeroplus Dispatch

Back disorders have long been recognized as a serious problem within the military aviation community and a possible threat to mission accomplishment. The purpose of the present study was to determine the extent to which the type of aircraft flown is associated with diagnosed back problems, and to examine differences in the prevalence of back disorders between pilots and aircrew. A case-control study was conducted in which U.S. Navy pilots and aircrew members with a diagnosed back disorder on their most recent physical exam between 1991 and 1993 were compared with pilots and aircrew without such diagnoses. Data were obtained from the automated physical examination records maintained by the Naval Operational Medicine Institute for all Naval aviation personnel. Results showed that aircrew members have a higher risk of diagnosed back problems than pilots for both helicopters and fixed-wing aircraft. The study revealed that flight engineers have a higher risk of diagnosed back problems than other aircrew members. Among pilots, no association was found between type of aircraft and diagnosed back problems.
Author (AIAA)

Back Injuries; Aircraft Pilots; Flight Crews; Military Aircraft; Aerospace Medicine

19980071845

Long-term follow-up of aviators after functional endoscopic sinus surgery for sinus barotrauma

Parsons, David S., Missouri, Univ., Columbia, USA; Chambers, David W., Missouri, Univ., Columbia; Boyd, Edgar M., USAF, Wilford Hall Medical Center, USA; Aviation, Space, and Environmental Medicine; Nov. 1997; ISSN 0095-6562; Volume 68,, no. 11, pp. 1029-1034; In English; Copyright; Avail: Aeroplus Dispatch

Prior to endonasal endoscopic advances for the treatment of sinus disease, surgical results for aviators with recurrent sinus barotrauma (RSB) were inconsistent. Between 1988 and 1992, 54 aviators, who were permanently or temporarily grounded, underwent functional endoscopic sinus (FES) surgery in an attempt to return them to active flying status. Follow-up in the immediate postoperative period revealed that 98 percent of these aviators returned to active flight duty. A questionnaire was mailed to each of these aviators to compare their preoperative and long-term postoperative symptoms and determine their current flying status. Longterm follow-up time ranged from 20 to 72 months, with average of 48 months. of the aviators who responded to the survey, 92 percent have continued their flying duties and do not report difficulties with RSB. We conclude that FES surgery is effective in the short- and long-term management RSB in aviators.
Author (AIAA)

Aircraft Pilots; Sinuses; Barotrauma; Endoscopes; Surgery

19980071849

High refractive errors and the accident/incident rate in Canadian medical Category 1 pilots

Wallace, J. M., Canadian Civil Aviation Medicine Division, Canada; Liddy, B., Canadian Civil Aviation Medicine Division, Canada; Charbonneau, H., Canadian Civil Aviation Medicine Division, Canada; Balfour, D., Canadian Civil Aviation Medicine Division, Canada; Wielgosz, A., Canadian Civil Aviation Medicine Division, Canada; Aviation, Space, and Environmental Medicine; Nov. 1997; ISSN 0095-6562; Volume 68,, no. 11, pp. 1050, 1051; In English; Copyright; Avail: Aeroplus Dispatch

Since 1982, the Canadian Civil Aviation Medicine Division (CAMD) has medically certified to Category 1 standard commercial and airline transport pilots whose visual correction was in excess of +/- 3.5 diopters (D). A review between the years 1982 and 1991 of the 253 pilots who had been medically certified, although they were outside the standard, was conducted. We determined if there was any difference in the accident/incident rate in this group as compared with the Canadian general aviation population standardized to a rate per 100,000 flying hours. The 253 pilots were divided into two groups with Group A having a refractive error outside the range +/- 5.7 D and Group B having a refractive error range of +/- 3.5 to +/- 5.6 D. The Group A rate was within the expected range of accidents and incidents per 100,000 flying hours. The accident/incident rate in Group B was significantly lower than the expected average. CAMD's policy on granting 'flexibility' to applicants with moderate to high refractive errors has not affected adversely the accident or incident rate and therefore has not compromised aviation safety.
Author (AIAA)
Aircraft Pilots; Visual Acuity; Aircraft Accidents

19980072335

Controller situation awareness in free flight

Endsley, Mica R., Texas Tech Univ., Lubbock, USA; Mogford, Richard H., FAA, William J. Hughes Technical Center, USA; Stein, Earl, FAA, William J. Hughes Technical Center, USA; 1997, pp. 4-8; In English; Copyright; Avail: Aeroplus Dispatch

This study provides an objective evaluation of some of the possible effects of free flight on controllers' ability to maintain an accurate and complete picture of the traffic situation. This picture or mental representation is essential for monitoring and separation functions. The study revealed that, using current technology, some aspects of free flight might adversely influence the situation awareness and performance of controllers. The results of this study provided information for better defining how free flight should be implemented and for determining needed design and procedural modifications to support the concept.
Author (AIAA)
Free Flight; Air Traffic Controllers (Personnel); Human Performance; Aircraft Control

19980072337

Success and failure at self-separation in simulated free flight

Smith, Kip, Minnesota, Univ., Minneapolis, USA; Briggs, Amy, Minnesota, Univ., Minneapolis; Knecht, William, Minnesota, Univ., Minneapolis; Hancock, Peter, Minnesota, Univ., Minneapolis; 1997, pp. 13-17; In English
Contract(s)/Grant(s): FAA-93-G-048; Copyright; Avail: Aeroplus Dispatch

Pilots in free flight will assume responsibility for self-separation. This paper discusses research that identifies constraints on a pilot's ability to maintain self-separation in free flight. It documents a principled approach to scoring the concurrent verbal reports of pilots engaged in simulated en route traffic scenarios. One such protocol is used to identify a mismatch between the tacit criteria for self-separation invoked by professional airline pilots and the separation criterion currently mandated by the FAA: 5 mi laterally and 1000 ft vertically.
Author (AIAA)
Free Flight; Aircraft Approach Spacing; Flight Simulation; Aircraft Control; Automated En Route ATC; Aircraft Pilots

19980072338

Free flight cockpit displays of traffic and weather - Effects of dimensionality and data base integration

O'Brien, Janelle V., Illinois, Univ., Savoy, USA; Wickens, Christopher D., Illinois, Univ., Savoy; 1997, pp. 18-22; In English
Contract(s)/Grant(s): NAG2-996; Copyright; Avail: Aeroplus Dispatch

In any free flight system, pilots must have displays which effectively depict traffic and weather information as more and more responsibility for separation from such hazards transfers from air traffic controllers to pilots. This research effort seeks to address the issues of dimensionality (3D vs 2D coplanar displays) and data-base integration (separation or integration of traffic and weather information within displays). Seventeen general aviation flight instructors flew a series of en route trials with four display types in which dimensionality, data base integration, and hazard geometries were manipulated. Analysis of the data revealed that the 2D displays resulted in a smaller percentage of conflicts with traffic and weather hazards. The results also suggested that displays in which traffic and weather were integrated resulted in fewer hazard conflicts for trials in which both hazard types were critical to maneuver selection. Maneuver strategy was also found to vary by scenario geometry.
Author (AIAA)
Free Flight; Display Devices; Air Traffic; Aviation Meteorology; Dimensions; Data Integration; Flight Hazards

19980072341

An investigation of helmet-mounted display field-of-view and overlap tradeoffs

Jennings, Sion, NRC of Canada, Ottawa, Canada; Dion, Manfred, German Armed Forces Flight Test Center, Germany; 1997, pp. 32-36; In English; Copyright; Avail: Aeroplus Dispatch

NRC researchers investigated the tradeoffs between binocular-overlap and FOV in helmet-mounted displays. Four test pilots performed a series of maneuvers in a helicopter while wearing FOV limiting goggles. They evaluated a monocular FOV, a range of binocular overlaps, and unrestricted vision. Pilots evaluated the system performance and handling qualities using Cooper-Harper Handling Qualities Ratings, visual cue ratings, and subjective comments. The handling qualities of the helicopter/pilot system changed in a nonlinear fashion as the binocular overlap increased. Pilot comments, preferences, and visual cue ratings showed the same trends as the handling qualities data. Practical applications of the results are discussed, including helicopter control system augmentation to allow improved performance in degraded visual conditions.

Author (AIAA)

Helmet Mounted Displays; Field of View; Tradeoffs; Binocular Vision; Monocular Vision; Helicopter Control; Pilot Performance; Controllability; Man Machine Systems

19980072343

On the application of cognitive compatibility to aircraft systems design and evaluation

Andre, Anthony D., Interface Analysis Associates, USA; 1997, pp. 43-45; In English; Copyright; Avail: Aeroplus Dispatch

Much research has been performed examining various aspects of the relationship between displays and controls in the aircraft cockpit as well as other, related contexts. Yet, the applicability of this work to the design or evaluation of modern aircraft systems is still limited. One reason for this limitation is the disproportionate focus on the physical (spatial) aspects of display-control relationships, often referred to as stimulus-response (S-R) compatibility, relative to the cognitive or perceptual aspects. Another reason for the limited applicability of this research to applied systems design is the lack of computer-aided models and automated tools which incorporate the established principles and guidelines. It is argued here that in order to optimize both the design process and design result of future cockpit interfaces, models of cognitive compatibility must be developed and incorporated into computer-based design and evaluation tools.

Author (AIAA)

Cognitive Psychology; Compatibility; Human Factors Engineering; Man Machine Systems; Display Devices; Aircraft Control; Control Systems Design

19980072346

New light through old windows - The role of cognitive compatibility in aircraft dial design

Banbury, Simon P., Defence Evaluation and Research Agency, UK; Selcon, Stephen J., Defence Evaluation and Research Agency, UK; McCrerie, Claire M., Defence Evaluation and Research Agency, UK; 1997, pp. 56-60; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports the results of a study investigating the role of cognitive compatibility in the design of aircraft dials. of particular relevance to this study is the relationship between the visual display and the required response. Using a four-by-four layout of aircraft engine dials, participants were instructed to respond to a single, disparate reading by making an appropriate left-right judgment. Both compatible and incompatible response mappings were tested: instruments grouped by engine (left and right), and instruments grouped by status (primary and secondary), respectively. The results indicated that a layout incompatible with the response significantly increased reaction times and error rate, regardless of graphical cues to encourage perceptual grouping into the correct response mapping. Finally, disparities between dial readings were harder to detect at oblique angles compared to those oriented to the horizontal axis. These results are interpreted in the light of current theories regarding cognitive compatibility and the oblique effect, and design guidelines for dials are discussed.

Author (AIAA)

Cognitive Psychology; Human Factors Engineering; Aircraft Instruments; Compatibility; Display Devices; Indicating Instruments

19980072348

Mechanical fault management in Navy helicopters

Deaton, John E., CHI Systems, Inc., USA; Glenn, Floyd A., III, CHI Systems, Inc., USA; Federman, Philip J., CHI Systems, Inc., USA; Nickerson, G. W., Pennsylvania State Univ., State College; Byington, Carl S., Pennsylvania State Univ., State College; Malone, Robert, Galaxy Scientific, USA; Stout, Renee, U.S. Navy, Naval Air Warfare Center, USA; Oser, Randall, U.S. Navy, Naval Air Warfare Center, USA; Tyler, Robert R., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 66-69; In English; Copyright;

Avail: Aeroplus Dispatch

The goal of this investigation was to conduct systematic interviews with flight crews regarding their information requirements for using new diagnostic systems to predict and mitigate inflight mechanical system emergencies. Future research in this area will determine how best to present information to the aircraft in order to improve aircraft safety and enhance mission effectiveness.

Author (AIAA)

Management Methods; Fault Detection; Navy; Helicopters; Aircraft Maintenance; Mechanical Engineering

19980072349

Predictability as a metric of automation complexity

Vakil, Sanjay S., MIT, USA; Hansman, R. J., MIT, USA; 1997, pp. 70-74; In English; Copyright; Avail: Aeroplus Dispatch

Current advanced commercial transport aircraft rely on flight management systems. The increasing complexity of these systems has caused an increase in errors in interaction with aircraft automation. Previous research focused on identification of the elements of automation (mode structure, consistency, command languages, etc.) which may lead to faulty human-automation interactions. These approaches require the complex system to have underlying structure in an available and communicable form. In contrast, this paper discusses a more easily testable 'end-to-end' metric which can be used independently of a knowledge of this structure. The concept of predictability is presented as a candidate metric of the complexity of automation and is defined as a measure of how well an operator can anticipate what the system will do at some point in the future. The goal of this work is to identify areas of flight management systems which have a strong impact on predictability to provide guidance in future designs and in current pilot training.

Author (AIAA)

Flight Management Systems; Automation; Complex Systems; Prediction Analysis Techniques; Commercial Aircraft; Man Machine Systems; Pilot Training

19980072350

Automation in general aviation. II - Four ways to reach zero feet AGL unintentionally: Autopilot and pitch trim malfunctions

Beringer, Dennis B., FAA, Civil Aeromedical Inst., USA; Harris, Howard C., Jr., FAA, Civil Aeromedical Inst., USA; 1997, pp. 75-79; In English; Copyright; Avail: Aeroplus Dispatch

Part I of this study examined four automation-related malfunctions and subsequent pilot responses. The present study examined four additional malfunctions, two more obvious (runaway pitch-trim down, runaway roll servo) and two more subtle (failed attitude indicator, pitch sensor drift down) than those in Part I, and the effect of an auditory warning. Data collection was performed in the Civil Aeromedical Institute's Advanced General Aviation Research Simulator, configured as a Piper Malibu. Results suggest that the first three of these failures may, in a significant percentage of cases (13 of 24 in the sample), lead to significant altitude loss, overstress of the airframe, disorientation of the pilot, or destruction of the aircraft. Percentages of successful recoveries, detection/correction times, and related indices of performance are discussed in the context of malfunction type, flight profile, and auditory alerts.

Author (AIAA)

General Aviation Aircraft; Automation; Aerodynamic Balance; System Failures; Malfunctions; Pitch (Inclination); Automatic Pilots; Man Machine Systems

19980072354

A full mission simulation success story - RPA simulation at CSRDF yields promising results

Casper, Patricia A., Monterey Technologies, Inc., USA; 1997, pp. 95-99; In English; Copyright; Avail: Aeroplus Dispatch

In support of the U.S. Army's Rotorcraft Pilot's Associate Advanced Technology Demonstration Program, the Crew Station Research and Development Branch (CSRDB) at NASA/Ames has recently completed a full mission simulation (FMS) experiment testing two alternative mission equipment packages (MEPs). Four crews of Army helicopter pilots flew 64 trials, performing representative combat helicopter tasks. Objective and subjective performance metrics provided statistically significant data supporting a priori hypotheses about performance differences between the two systems. Crews flying the advanced MEP killed more targets more efficiently, and were killed fewer times than when flying the baseline MEP. In addition, their workload was lower, and subjectively assessed situation awareness was higher with the advanced system. These results are encouraging for full mission simulation research, and suggest that a standard empirical model may in fact be applicable to full mission simulation.

Author (AIAA)

Military Helicopters; Research and Development; Crew Workstations; Pilot Support Systems; Combat; Flight Simulation; Systems Simulation; Man Machine Systems

19980072367

Aircrew response procedures to inflight mechanical emergencies

Deaton, John E., CHI Systems, Inc., USA; Glenn, Floyd A., III, CHI Systems, Inc., USA; Federman, Philip J., CHI Systems, Inc., USA; Nickerson, G. W., Pennsylvania State Univ., State College; Byington, Carl S., Pennsylvania State Univ., State College; Malone, Robert, Galaxy Scientific, USA; Stout, Renee, U.S. Navy, Naval Air Warfare Center, USA; Oser, Randall, U.S. Navy, Naval Air Warfare Center, USA; Tyler, Robert R., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 234-237; In English; Copyright; Avail: Aeroplus Dispatch

The central goal of this investigation was to study crew response procedures to inflight mechanical system emergencies. This study assessed those cognitive activities found to be important when responding to mechanical emergencies and the attention that is devoted to each of these activities. Participants are required to fly a predetermined mission scenario in which mechanical system failures were introduced. Aircrews were asked to identify the procedures that were triggered by each problem condition, and how their attention was allocated to various cognitive activities. The usefulness of a preliminary taxonomic structure that was developed to characterize the cognitive activities of aircrews engaged in a simulated flight scenario will become apparent during actual interface development. These activities will be translated into interface design and functionality requirements to support new sensor/diagnostic technologies currently being developed.

Author (AIAA)

Flight Crews; Emergencies; System Failures; Aircraft Hazards; Aircraft Equipment; Man Machine Systems; Human Reactions

19980072376

Effects of scene-linked symbology on flight performance

Shelden, Stephen G., San Jose State Univ., USA; McCann, Robert S., San Jose State Univ., USA; Foyle, David C., NASA Ames Research Center, USA; 1997, pp. 294-298; In English; Copyright; Avail: Aeroplus Dispatch

Previous research has shown that the presence of aircraft HUD symbology indicating altitude improves maintenance of altitude, but at a cost to (ground) path-following ability. We term this the altitude/path performance trade-off. Differential motion between HUD symbology and the world has been posited as leading to attentional tunneling on the symbology at the expense of flight information in the world. In the first of two flight simulation studies, scene-linked symbology was tested to see if the absence of differential motion cues between the symbology and the world would negate attentional tunneling and the resulting performance trade-off. This not only proved to be the case, but relative to a control condition with no explicit altitude display, scene-linked symbology yielded improved altitude and path performance. In the second study, an attempt was made to discern the source of improvement in path performance found with the use of scene-linked symbology. The result suggests that flight task integration and fusion of the symbology with the world permits object-based parallel processing benefits that are evidenced by improved path-following performance.

Author (AIAA)

Symbols; Head-Up Displays; Aircraft Performance; Flight Instruments; Flight Simulation; Man Machine Systems

19980072377

Tactical aviation and human factors - Designing the SIRE supercockpit

Brickman, Bart J., Logicon Technical Services, Inc., USA; Hettinger, Lawrence J., Logicon Technical Services, Inc., USA; Haas, Michael W., USAF, Armstrong Lab., USA; 1997, pp. 299-303; In English; Copyright; Avail: Aeroplus Dispatch

Modern air combat represents a highly complex, dynamic domain that presents many significant challenges for military aviators. Current military aircraft provide much more complex dynamic information than a single human has the ability to simultaneously attend to, let alone comprehend. As technological developments lead to the deployment of enhanced capabilities for information sharing, this trend is expected to continue. Consequently, a significant challenge for aircraft interface designers is to provide mission critical information to pilots in a rapid and effective manner, and to facilitate intuitive and accurate comprehension and operation of aircraft systems. This paper describes the process and one product of an approach to the design of future tactical crewstations that employs human performance evaluations as a design tool, and is offered as a model for the development of any complex system in which enhanced human performance is the desired outcome.

Author (AIAA)

Human Factors Engineering; Cockpits; Military Aviation; Environment Simulation; Crew Workstations; Human Performance; Complex Systems

19980072378

Measuring human detection performance in aircraft visual inspection

Drury, Colin G., New York, State Univ., Buffalo, USA; Spencer, Floyd W., Sandia National Labs., USA; Schurman, Donald L., Idaho National Engineering and Environmental Lab., Idaho Falls; 1997, pp. 304-308; In English; Copyright; Avail: Aeroplus Dispatch

In airworthiness assurance, while there is a long tradition of measuring inspection reliability for machine-aided NDI, the more common visual inspection has received little attention. Yet inspection reliability measurements are needed if we are to set appropriate inspection intervals for airframe components. Visual inspection of aircraft is characterized as using multiple senses (despite its name) and having to inspect for multiple fault types, in contrast to NDI which is used for single specific fault types. The study here used 12 professional inspectors to perform nine visual inspection tasks on a long-service Boeing 737 aircraft. Each inspector worked over two days. Measures were taken of performance, strategy, and individual differences. Only a fraction of the results are presented here, with a major finding that aircraft visual inspection has approximately the same reliability as industrial inspection. Individual differences were found, as well as correlations between certain aspects of performance and individual characteristics such as field independence and peripheral visual acuity. However, there was little correlation between an individual inspector's performance on the different tasks, showing the difficulty of designing selection and placement procedures for such a wide-ranging job.

Author (AIAA)

Inspection; Human Performance; Fault Detection; Aircraft Structures; Reliability Analysis; Visual Tasks

19980072385

Beyond 'hits' and 'misses' - Evaluating performance on typical inspection tasks of regional airline inspectors

Wenner, Caren, New York, State Univ., Buffalo, USA; Wenner, Frederick, New York, State Univ., Buffalo; Drury, Colin, New York, State Univ., Buffalo; Spencer, Floyd, Sandia National Labs., USA; 1997, pp. 579-583; In English; Copyright; Avail: Aeroplus Dispatch

Eleven inspectors from regional airlines participated in a study on inspection performance conducted at the FAA's Airworthiness Assurance NDI Validation Center (AANC) at Sandia Laboratories. These inspectors were asked to perform six inspection tasks, typical of inspections performed in their airline's maintenance department, on a testbed aircraft using workcards developed by the researchers. Performance on these six tasks varied widely between inspectors. Differences in performance were due to three main factors: differences in the domain knowledge of the inspectors, differences in workcard familiarity, and differences in the way the tasks were approached. The major factor seemed to be the individual's approach to the tasks.

Author (AIAA)

Inspection; Airline Operations; Passenger Aircraft; Commercial Aircraft; Aircraft Maintenance; Human Performance

19980072397

Enhancing system safety with 3-D audio displays

Haas, Ellen C., U.S. Army, Research Lab., USA; Gainer, Charles, U.S. Army, Research Inst., USA; Wightman, Dennis, U.S. Army, Research Inst., USA; Couch, Michael, Anacapa Sciences, USA; Shilling, Russell, U.S. Air Force Academy, USA; 1997, pp. 868-872; In English; Copyright; Avail: Aeroplus Dispatch

The enhancement of multiple radio communications can be an important system safety consideration. This study was conducted to determine how accurately helicopter pilots could process radio communications information in a simulated cockpit environment when the messages were presented under different modes (diotic, dichotic, and 3D audio). The dependent variable was the total number of points scored in the radio communications identification task. Subjects were 11 certified U.S. Army AH-64 pilots between the ages of 18 and 35 who possessed hearing and visual acuity within thresholds acceptable to the U.S. Army. Multivariate statistical analysis indicated that presentation mode was significant. Pilots scored the greatest number of points in the identification task while using 3D audio, fewer with dichotic presentation, and the least with diotic presentation. There was a statistically significant difference between the 3D and the diotic presentation. The data imply that 3D audio provides an effective mode of message presentation in systems with multiple radio communications.

Author (AIAA)

Radio Communication; Aircraft Pilots; Aircraft Communication; Message Processing; Aviation Psychology; Cognitive Psychology

19980072398

A novel flight instrument display to minimize the risk of spatial disorientation

Braithwaite, Malcolm G., U.S. Army, Aeromedical Research Lab., USA; Durnford, Simon J., U.S. Army, Aeromedical Research Lab., USA; 1997, pp. 897; In English; Copyright; Avail: Aeroplus Dispatch

This novel flight instrument display presents information to the pilot in a simple and easily comprehensible format by integrating the five orientational flight parameters (aircraft attitude, airspeed, altitude, rate of climb or descent, and aircraft heading). It

allows the pilot to select specific orientation parameters and then follow a simple tracking task which ensures that these parameters are maintained or, if necessary, recovered. Our assessment of the display in a UH-60 helicopter simulator showed that the novel display makes recovery from unusual aircraft attitudes and instrument flying more accurate, and easier than when using a standard instrument panel. The display will be demonstrated.
Author (AIAA)
Display Devices; Flight Instruments; Disorientation; Flight Safety; Flight Control

19980072399

Overview of the Advanced Qualification Program

Longridge, Thomas M., FAA, USA; 1997, pp. 898-901; In English; Copyright; Avail: Aeroplus Dispatch

The Advanced Qualification Program (AQP) is a voluntary alternative to the traditional regulatory requirements under CFR 14, Parts 121 and 135 for pilot training and checking. Under the AQP the FAA is authorized to approve significant departures from traditional requirements, subject to justification of an equivalent or better level of safety. The program entails a systematic from-end analysis of training requirements from which explicit proficiency objectives for all facets of pilot training are derived. It seeks to integrate the training and evaluation of cognitive skills at each stage of a curriculum. For pass/fail purposes, pilots must demonstrate proficiency in scenarios that test both technical and crew resource management skills together. Air careers participating in the AQP must design and implement data collection strategies which are diagnostic of cognitive and technical skills. In addition, they must implement procedures for refining curricula content based on quality control data. This paper presents an overview of the Advanced Qualification Program and identifies selected applied research issues of interest to the FAA for the purpose of improving the program.
Author (AIAA)
Qualifications; Pilot Training; Flight Safety

19980072401

Line Operational Evaluation (LOE) air carrier scenario based evaluation

Hamman, William R., United Airlines, USA; Holt, Robert W., George Mason Univ., USA; 1997, pp. 907-911; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a methodology for developing Line Operational Evaluations (LOEs) which assess crew and individual pilot proficiency in the FAA's Advanced Qualification Program (AQP). Under AQP, Crew Resource Management (CRM) skills are trained and assessed along with technical maneuvers in the issuing of an Airmen type certification. The environment for assessing this technical and CRM proficiency is the LOE which must be designed and implemented under strict adherence to the requirements of AQP. This paper discusses the five major steps in the design process, the issues associated with scenario based measurement of pilot proficiency, and the application of statistical analysis to improve evaluator standardization and the reliability and validity of data.
Author (AIAA)
Methodology; Pilot Training; Training Evaluation; Flight Simulation

19980072402

Rapidly reconfigurable event-set based line operational evaluation scenarios

Bowers, Clint, Central Florida, Univ., USA; Jentsch, Florian, Central Florida, Univ., USA; Baker, David, Central Florida, Univ., USA; Prince, Carolyn, U.S. Navy, USA; Salas, Eduardo, U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 912-915; In English; Copyright; Avail: Aeroplus Dispatch

An important cornerstone of the Advanced Qualification Program is the use of realistic flight simulations to train flight crews and evaluate their proficiency. This is achieved through the use of Line Operational Simulations (LOSs) which contain a number of realistic event sets that require flight crews to use the knowledge, skills, and abilities they gained in training in both technical and crew resource management areas. In the past, the development of LOS scenarios was complex, expensive, and time-consuming. As a result, the number of LOS scenarios used by any particular training organization was limited. This may have led, in some cases, to the LOS scenarios being compromised among flight crews, thus reducing the validity and reliability of the assessment process. In response to this problem, it has been suggested to create a methodology for quickly reconfiguring the content of flight simulator LOS scenarios. This paper provides a background for this new development and describes a research project that was begun in response to this need. A number of specific research questions are discussed which need to be answered before the methodology can be adopted by participants in the AQP program.
Author (AIAA)
Flight Training; Flight Crews; Flight Simulation; Training Evaluation; Methodology; Qualifications

19980072403

Application of psychometrics to the calibration of air carrier evaluators

Holt, Robert W., George Mason Univ., USA; Johnson, Peder J., New Mexico, Univ., Albuquerque; Goldsmith, Timothy E., New Mexico, Univ., Albuquerque; 1997, pp. 916-920; In English; Copyright; Avail: Aeroplus Dispatch

The FAA's Advanced Qualification Program (AQP) encourages airlines to implement proficiency-based training programs and requires collection of reliable and valid performance assessment data. We present applications of traditional and innovative psychometric methods to this domain.

Author (AIAA)

Psychometrics; Calibrating; Airline Operations; Flight Simulation; Training Evaluation; Flight Training

19980072411

Meaningful assessments of simulator performance and sickness - Can't have one without the other?

Bittner, Alvah C., Jr., Battelle Seattle Research Center, USA; Gore, Brian F., Battelle Seattle Research Center, USA; Hooey, Becky L., Battelle Seattle Research Center, USA; 1997, pp. 1089-1093; In English; Copyright; Avail: Aeroplus Dispatch

The requirement to evaluate the differential impacts of simulator sickness on performance assessments was explored. Simulator sickness and performance data were analyzed in two phases that indicated: (1) an experimental display condition by age interaction with regard to development of simulator sickness; and (2) associated detrimental effects of simulator sickness on performance. Arguably, these results may be quite disturbing to users, and past users, of simulators for system and other Development, Test, and Evaluation efforts. The utility of simulator sickness measures as covariates, in the analysis of performance effects, is demonstrated as a means for their assessment and statistical control. It is strongly recommended that researchers explore and control the potential confounding effects of simulator sickness in order to assure meaningful performance assessments.

Author (AIAA)

Flight Simulators; Motion Sickness; Human Performance

19980072414

Low-Altitude Parachute Extraction System (LAPES)

Gawron, Valerie J., Calspan SRL Corp., USA; Lopez, Miguel, USAF, Flight Test Center, USA; 1997, pp. 1103-1106; In English; Copyright; Avail: Aeroplus Dispatch

LAPES, a low-level self-contained extraction system capable of precision delivery of heavy loads into areas where other methods of aerial delivery or landing of aircraft are not possible or impractical, is discussed. The application to LAPES of Structured Test Procedures (STPs) for critical flight tests developed at the Air Force Flight Test Center is addressed.

AIAA

Parachutes; Low Altitude; Flight Tests; Knowledge Based Systems

19980072416

The use of executable cognitive models in simulation-based intelligent embedded training

Zachary, Wayne, CHI Systems, Inc., USA; Ryder, Joan, CHI Systems, Inc., USA; Hicinbothom, James, CHI Systems, Inc., USA; Bracken, Kevin, CHI Systems, Inc., USA; 1997, pp. 1118-1122; In English; Copyright; Avail: Aeroplus Dispatch

This paper defines a new role for expert models in intelligent embedded training-guiding practice. The integration of problem-based practice with focused, automated instruction has long proven elusive in training systems for complex real-world domains. The training strategy of 'guided practice' offers a way to merge the approaches of traditional simulation-based practice and intelligent tutoring's knowledge tracing. The performance of the trainee is dynamically assessed against scenario-specific expectations and performance standards, which are generated during the simulation by embedded models of expert operators. This research developed an executable cognitive model capable of solving realistic simulation scenarios in an expert-level manner, identified and implemented modifications and extensions to this baseline model needed to generate dynamic and adaptive expectations of future trainee actions, and developed means of providing cognitive state information for use in (separate) diagnostic processes, without resorting to fullscale knowledge tracing methods.

Author (AIAA)

Expert Systems; Flight Simulators; Flight Training

19980072417

Requirements for objective- and performance-based creation and modification of complex training materials

Stretton, Milton L., Sonalyst, Inc., USA; Cannon-Bowers, Janis A., U.S. Navy, Naval Air Warfare Center, USA; 1997, pp. 1128-1132; In English; Copyright; Avail: Aeroplus Dispatch

Implementation of simulation and scenario based training for teams and individuals requires generation and delivery of highly complex instructional material. In this paper, preliminary results of a multiyear effort are presented with a focus on scenario development tools in support of advanced individual and team training. As a first step in this effort, a review of the state-of-the-art in simulation- and scenario-based training systems was conducted examining over 20 simulation and scenario-based training systems. Consistently recurring limitations were evident across all systems in all aspects from preparation to debrief. These limitations, together with other research in automated data collection and diagnosis, have focused attention on the development of a 'learner centered', software-based training management system. The effort described herein supports the building of a system that allows relative novices to use historical performance data to create and modify scenarios based on specific objectives. This system will also create appropriate support materials for training personnel. Success in this endeavor will provide a model for those who have straggled to harness the considerable potential afforded by simulation- and scenario-based training.
Author (AIAA)
Flight Training; Flight Simulation; Computer Programs

19980072418

Cybersickness is not simulator sickness

Stanney, Kay M., Central Florida, Univ., USA; Kennedy, Robert S., Essex Corp., USA; Drexler, Julie M., Essex Corp., USA; 1997, pp. 1138-1142; In English

Contract(s)/Grant(s): NAS9-19482; NAS9-19453; NSF DMI-95-61266; NSF IRI-96-24968; Copyright; Avail: Aeroplus Dispatch

Factor analysis of a large number of motion sickness self-reports from exposure to military flight simulators revealed three separate clusters of symptoms. Based on this analysis a symptom profile emerged for simulators where oculomotor symptoms predominated, followed by nausea and last by disorientation-like symptoms. Current users of virtual environment (VE) systems have also begun to report varying degrees of what they are calling cybersickness, which initially appeared to be similar to simulator sickness. We have found, after examination of eight experiments using different VE systems, that the profile of cybersickness is sufficiently different from simulator sickness - with disorientation being the predominant symptom and oculomotor the least. The total severity of cybersickness was also found to be approximately three times greater than that of simulator sickness. Perhaps these different strains of motion sickness may provide insight into the different causes of the two maladies.
Author (AIAA)
Motion Sickness; Flight Simulators; Factor Analysis

19980072421

Computer-based team training - The aircraft maintenance environment example

Kraus, David, Galaxy Scientific Corp., USA; Gramopadhye, Anand K., Clemson Univ., USA; Greenstein, Joel S., Clemson Univ., USA; Nowaczyk, Ronald H., Clemson Univ., USA; 1997, pp. 1154-1157; In English; Copyright; Avail: Aeroplus Dispatch

This research looked at the role of team training in aircraft maintenance, specifically that of advanced technology for team training. A controlled study was conducted to evaluate the effectiveness of advanced technology for team training. The study was conducted in two phases: (1) instructional phase where 18 subjects received training through a computer-based team training program and 18 subjects received training using a traditional instructor-based equivalent team training program, and (2) evaluation phase where the subjects were divided into three member teams and performance of the teams was evaluated as they completed a routine and a nonroutine maintenance task. The results of the study are reported as part of this paper.
Author (AIAA)
Computer Techniques; Aircraft Maintenance; Maintenance Training; Training Evaluation; Teams

19980072422

A design aid for improved documentation in aircraft maintenance - A precursor to training

Drury, Colin G., New York, State Univ., Buffalo, USA; Sarac, Abdulkadir, New York, State Univ., Buffalo; 1997, pp. 1158-1162; In English; Copyright; Avail: Aeroplus Dispatch

With the increasing demand for error reduction in civil aviation maintenance has come a need to ensure that complex work instructions are presented so as to minimize error opportunities. Guidelines have been developed for improving human factors aspects of work control cards and proven effective in the design of both paper-based and computer-based. The current study examined ways of providing such guidelines in a form which document writers will use. Guideline content came from a literature search, plus currently-available design guides. Guideline structure was developed in conjunction with a user team at a partner airline. Both paper-based and computer-based versions of a Documentation Design Aid (DDA) were developed, with iterative input from the user team. These versions were tested on engineering technical writers to measure performance and usability, with

generally positive results. The user team approach produced a list of issues in documentation which went beyond document design into the whole document production/testing/using process. Thus, an effort parallel to the design aid development resulted in a review of the macro-ergonomic aspects of the work documentation system.
Author (AIAA)
Aircraft Maintenance; Maintenance Training; Documentation; Technical Writing

19980072423

Development of a situation awareness training program for aviation maintenance

Robertson, Michelle M., Southern California, Univ., USA; Endsley, Mica R., MIT, USA; 1997, pp. 1163-1167; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes a training program designed to enhance situation awareness across the multiple, distributed teams found in aircraft maintenance. Problems with poor situation awareness in aircraft maintenance and gaps in situation awareness across the multiple teams engaged in this process have been linked to aircraft accidents, damage and inefficiencies in airline operations. The training program was developed based on an instructional systems design model. A front-end analysis was conducted which resulted in a determination of instructional objectives and goals. Five concepts for training to improve team SA were specified and developed into a deliverable training program: shared mental models, verbalization of decisions, shift meetings and teamwork, provision of feedback, and individual SA training. The instructional design process used and the Team SA Training Program developed for this domain are discussed.
Author (AIAA)
Aircraft Maintenance; Maintenance Training

19980072424

Human factors training for aviation maintenance personnel

Johnson, William B., Galaxy Scientific Corp., USA; 1997, pp. 1168-1171; In English; Copyright; Avail: Aeroplus Dispatch

This paper discusses the growing demand and rationale for training related to human factors in aviation maintenance. The paper describes various course offerings and experiences of the author as a provider of maintenance human factors training.
Author (AIAA)
Human Factors Engineering; Aircraft Maintenance; Maintenance Training

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19980049183

Using modeling and simulation for rapid prototyping and system integration

Huang, Paul, United Defense LP, Armament Systems Div., USA; Kar, Pradip, United Defense LP, Armament Systems Div., USA; Fandrich, Chad, United Defense LP, Armament Systems Div., USA; 1997, pp. 2812-2817; In English; Copyright; Avail: Aeroplus Dispatch

This paper reports using the modeling and simulation based system integration approach to the development of the Bradley Fighting Vehicle A3 (BFV A3) System. BFV A3 System is a system upgrade of the existing BFV A2 System that is the backbone of the U.S. Army mechanized infantry. The upgrade enhances system performance by adopting new fire control and full digitization of the vehicle control system. The integration window was reduced from 18 months to six months by using this revolutionary approach. The modeling and simulation based system integration approach also produced powerful tools to perform over 80 percent of testing and evaluation (T&E) functions.
Author (AIAA)
Systems Integration; Life Cycle Costs; Computer Aided Design; Flight Vehicles; Systems Simulation

19980049187

Web-based distributed interactive simulation using Java

Narayanan, S., Wright State Univ., USA; Cowgill, J., Wright State Univ., USA; Malu, P., Wright State Univ., USA; Nandha, H., Wright State Univ., USA; Patel, C., Wright State Univ., USA; Schneider, N., Wright State Univ., USA; Tendulkar, J., Wright State Univ., USA; Carrico, T. M., USAF, Armstrong Lab., USA; DiPasquale, J., USAF, Armstrong Lab., USA; 1997, pp. 2690-2695;

In English; Copyright; Avail: Aeroplus Dispatch

Interfaces in interactive simulations not only display the state of the simulated system, but also allow an analyst to interact with the executing simulation. As the simulation executes in real time or scaled time, the analyst can modify the parameters and alter the dynamics of the simulated system. The major challenges in developing interactive simulations are problems associated with computer hardware and software. In this article, we describe an approach in applying the Internet infrastructure in overcoming the hardware and software problems associated with the development of interactive simulations. We present a portable object-oriented interactive simulation architecture, called JADIS-Web, implemented in Java. Through our architecture, users can interact concurrently with the simulation from distributed locations through an Internet browser. We discuss the components of the architecture and outline its application to an aircraft repair time analysis problem in the domain of airbase logistics.

Author (AIAA)

World Wide Web; Distributed Interactive Simulation; Software Development Tools; Aircraft Industry; Object-Oriented Programming

19980049287

CAD to SFT, with aeronautical applications

Spalding, Brian, Concentration Heat and Momentum, Ltd., UK; 1998, pp. S7-1 to S7-32; In English; Copyright; Avail: Aeroplus Dispatch

The basic principles and applications of computer aided design (CAD) and simultaneous solid stress, fluid flow, and thermal analysis (SFT) are reviewed. In particular, attention is given to the current capabilities of CAD; computer-aided stress analysis (CASA); computational fluid dynamics (CFD); and examples of specific applications. The current status and future prospects of the SFT technique are then briefly discussed. The use of SFT analysis is illustrated for a thick-walled pipe and for a radiation-heated convection-cooled block.

AIAA

Software Development Tools; Computational Fluid Dynamics; Computer Techniques; Electronic Packaging; Computational Grids; Airfoil Profiles

19980049334

Iterative learning-based extraction of aerobomb drag

Chen, Yangquan, National Univ. of Singapore, Singapore; Xu, Jian-Xin, National Univ. of Singapore, Singapore; Wen, Changyun, Nanyang Technological Univ., Singapore; Journal of Spacecraft and Rockets; Apr. 1998; ISSN 0022-4650; Volume 35, no. 2, pp. 237-240; In English; Copyright; Avail: Aeroplus Dispatch

The 'iterative learning' method is applied to an optimal tracking control problem related to aerodynamic property curve extraction from flight test data. Convergence is found to be robust to the initial control guess, and several choices of learning gains are considered with a view to better convergence performance. The effectiveness of the iterative learning scheme is validated in view of flight test data from three bombing flight paths.

AIAA

Iterative Solution; Aerodynamic Drag; Bombs (Ordnance); Learning Curves

19980049531

Traditional and evolved dynamic neural networks for aircraft simulation

Heimes, Felix, Lockheed Martin Corp., USA; Zalesski, George, Lockheed Martin Corp., USA; Land, Walker, Jr., New York, State Univ., Binghamton; Oshima, Michiharu, New York, State Univ., Binghamton; 1997, pp. 1995-2000; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents results in applying gradient and Evolutionary Programming (EP) techniques to training dynamic neural network models of aircraft response. The gradient methods modify the weights of pre-defined neural network structures to learn the desired mapping. We show that this approach is quite effective as long as the pre-defined network topology is capable of modeling the dynamic system. We examine several dynamic neural network structures: two recurrent architectures and the Memory Neuron Network. The EP algorithm determines not only the weights of a dynamic neural network, but also the topology. The EP algorithm is applicable to a much broader class of problems, since a pre-defined topology does not need to be in place beforehand, and the dynamics of the system do not need to be known.

Author (AIAA)

Aircraft Models; Neural Nets; Computerized Simulation; Computer Programming; Dynamic Models

19980053567 NASA Langley Research Center, Hampton, VA USA

The Aircraft Morphing Program

Wlezien, R. W., NASA Langley Research Center, USA; Horner, G. C., NASA Langley Research Center, USA; McGowan, A. R., NASA Langley Research Center, USA; Padula, S. L., NASA Langley Research Center, USA; Scott, M. A., NASA Langley Research Center, USA; Silcox, R. J., NASA Langley Research Center, USA; Simpson, J. O., NASA Langley Research Center, USA; 1998; 14p; In English; Structures, Structural Dynamics, and Materials Conference and Exhibit, 20-23 Apr. 1998, Long Beach, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-1998-208150; NAS 1.15:208150; AIAA Paper 98-1927; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the last decade smart technologies have become enablers that cut across traditional boundaries in materials science and engineering. Here we define smart to mean embedded actuation, sensing, and control logic in a tightly coupled feedback loop. While multiple successes have been achieved in the laboratory, we have yet to see the general applicability of smart devices to real aircraft systems. The NASA Aircraft Morphing program is an attempt to couple research across a wide range of disciplines to integrate smart technologies into high payoff aircraft applications. The program bridges research in seven individual disciplines and combines the effort into activities in three primary program thrusts. System studies are used to assess the highest- payoff program objectives, and specific research activities are defined to address the technologies required for development of smart aircraft systems. In this paper we address the overall program goals and programmatic structure, and discuss the challenges associated with bringing the technologies to fruition.

Author

Control Systems Design; Aircraft Design; Cost Reduction; Aeronautical Engineering; Technology Utilization

19980054121

Integrated undergraduate teaching laboratory approach to multivariable control

Kocijan, Jus, Univ. of Ljubljana, Slovenia; O'Reilly, John; Leithead, William E.; IEEE Transactions on Education; Nov, 1997; ISSN 0018-9359; Volume 40, no. 4, pp. 266-272; In English; Copyright; Avail: Issuing Activity

This paper discusses an integrated teaching laboratory approach to multivariable control as part of final year undergraduate and graduate control courses successfully taught by the authors in recent years. The perceived jump in mathematical sophistication required of students and the uneasy fit with previously learned classical control material are eliminated. One such laboratory teaching situation is described in detail. This concerns the multivariable control of a two-input two-output coupled-drives apparatus where the control objective is the simultaneous control of belt speed and tension using the input voltages to the two servo drive motors as control inputs. As with classical single-input single-output (SISO) control, student tasks involve plant modeling, analysis, specification, design, and implementation in that order. The multivariable control approach adopted is known as Individual Channel Analysis and Design (ICAD). of particular value to students and instructors alike is the fact that this approach to multivariable control is very classical-like in its motivations and feel while fully cognizant of multivariable structure. As a result, multivariable control that directly extends classical control principles is well within the reach of final year undergraduate students in an integrated teaching laboratory environment.

Author (EI)

Approach Control; Multivariable Control; Education; Control; Systems Analysis; Control Systems Design

19980054162

Spectra of quasienergies

Geisler, Lyn, III, Randolph-Macon Coll., USA; Howland, James S.; Journal of Mathematical Analysis and Applications; Mar 15, 1997; ISSN 0022-247X; Volume 207, no. 2, pp. 397-408; In English; Copyright; Avail: Issuing Activity

The spectra of the Floquet operator for the standard kicked rotor and the quasiperiodic Rabi oscillator are generically purely continuous. For the kicked rotor, the spectrum is purely singular continuous for a generic set of kick potentials with bounded variation.

Author (EI)

Floquet Theorem; Hamiltonian Functions; Spectrum Analysis; Operators (Mathematics); Rotors; Set Theory

19980058388

An introduction to evolutionary algorithms and their application to the aerofoil design problem. I - The algorithms

De Falco, I., CNR, IRSIP, Italy; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper is the first part of a short course designed to describe the introduction of evolutionary algorithms (EAs) as an effective means for the solution of the airfoil design optimization in aerodynamics. In this paper the basic ideas underlying EAs are outlined. Several versions of EAs are briefly described, with emphasis on their similarities and differences.
Author (AIAA)
Airfoil Profiles; Structural Design; Genetic Algorithms

19980055390
A graphically interactive design environment for multi-component airfoils
Baker, Daniel P., Pennsylvania State Univ., University Park, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0003; Copyright; Avail: Aeroplus Dispatch

A software package was developed to aid the design of multi-sectioned airfoil shapes. The program is fully graphical and interactive, and runs in IBM PC Windows format in real time. Aerodynamic analysis is performed using a fast, 2D boundary element code with assumptions of steady, inviscid, irrotational flow. An elastic membrane concept for inverse shape design is implemented, allowing a guessed multi-component configuration to evolve iteratively into a new configuration with a specified target distribution of surface pressure coefficient. The program allows for on-screen drag-and-drop mouse-controlled alterations of geometry and target surface pressure distributions. The code is written in C++ programming language using Borland's Object Windows for graphics and menu implementation, and an object-oriented programming style for hierarchical structure and full modularity.
Author (AIAA)
Airfoil Profiles; Software Development Tools; Computer Graphics; Computer Aided Design; Windows (Computer Programs)

19980055429
Second-order implicit schemes that satisfy the GCL for flow computations on dynamic grids
Koobus, Bruno, Colorado, Univ., Boulder, USA; Farhat, Charbel, Colorado, Univ., Boulder; Jan. 1998; In English
Contract(s)/Grant(s): NSF ACS-92-17394; F49620-97-1-0059
Report No.(s): AIAA Paper 98-0113; Copyright; Avail: Aeroplus Dispatch

We consider the solution of three-dimensional flow problems with moving boundaries using the Arbitrary Lagrangian Eulerian formulation or dynamic meshes. We focus on the case where spatial discretization is performed by unstructured finite volumes or finite elements. We formulate the consequence of the Geometric Conservation Law on the second-order implicit temporal discretization of the semi-discrete equations governing such problems, and use it as a guideline to construct a new family of second-order time-accurate and geometrically conservative implicit numerical schemes for flow computations on moving grids. We apply these new algorithms to the solution of three-dimensional flow problems with moving and deforming boundaries, demonstrate their superior accuracy and computational efficiency, and highlight their impact on the simulation of fluid/structure interaction problems.
Author (AIAA)
Euler-Lagrange Equation; Conservation Laws; Finite Volume Method; Aeroelasticity

19980055434
A new approach for efficient construction of asymptotic solutions of the two-dimensional Euler equations
Verhoff, A., Boeing Co., USA; Cary, A., Boeing Co., USA; Epstein, R., Boeing Co., USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0122; Copyright; Avail: Aeroplus Dispatch

A new method for analytical solution of the two dimensional, steady-state Euler equations is presented. The equations are written with flow angle and mass flux as dependent variables and streamline coordinates as independent variables. The solution procedure uses an asymptotic formulation wherein higher-order compressibility effects appear as nonhomogeneous forcing terms. A sequence of transformations, mappings and asymptotic methods places the Euler equations in the form of a boundary value problem amenable to solution using classical mathematical techniques. Mass flux as a dependent variable permits extension of the new approach to transonic flow. For airfoil problems, the nonhomogeneous solution can be constructed from closed-form indefinite integrals. The approach is derived herein for airfoil-type flows. Extensive use can be made of symbolic manipulation software. The new procedure is computationally orders of magnitude more efficient than the conventional CFD approach because it requires only function evaluations. Results are presented which demonstrate the potential efficiency improvements that can be realized by this approach.
Author (AIAA)
Two Dimensional Flow; Euler Equations of Motion; Asymptotic Methods; Aerodynamic Characteristics; Transonic Flow

19980055481

High Speed Civil Transport (HSCT) flight simulation and analysis software development

Lavretsky, Eugene, Boeing Co., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0173; Copyright; Avail: Aeroplus Dispatch

Nonlinear 6-DOF aircraft simulation development is highly complex, and frequently results in a computationally intensive computer code. Simulation requirements include multidimensional data table look-up schemes, differential equation integration, and storage of data needed for postsimulation analysis. In the present research, a methodology has been developed in which an existing (traditionally complex) simulation code is accessed through a MATLAB/SIMULINK interface. This allows for simple, block diagram representation of all input and output variables, and permits users from multiple disciplines (control law design, configuration assessment) to use the simulation as an analysis tool. Further, a graphical user interface is developed such that the user need only possess basic knowledge about aircraft dynamics and control to successfully simulate aircraft flight. A novel method of modeling aircraft dynamic aeroelastics is introduced. The method preserves nonlinear quasi-static aircraft characteristics while augmenting the system with linear structural modal dynamics.

Author (AIAA)

Flight Simulation; Computer Programs; Aircraft Models; Systems Simulation

19980055925

Reduction and analysis of phosphor thermography data with the IHEAT software package

Merski, N. R., NASA Langley Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0712; Copyright; Avail: Aeroplus Dispatch

Detailed aeroheating information is critical to the successful design of a thermal protection system (TPS) for an aerospace vehicle. This report describes the NASA-Langley (LaRC) two-color relative-intensity phosphor thermography method and the IHEAT software package which is used for the efficient data reduction and analysis of the phosphor image data. The phosphor methodology at LaRC is presented including descriptions of phosphor model fabrication, test facilities and phosphor video acquisition systems. A discussion of the calibration procedures, data reduction and data analysis is given. Estimates of the total uncertainties (with a 95 percent confidence level) associated with the phosphor technique are shown to be approximately 8 to 10 percent in the Langley's 31-Inch Mach 10 Tunnel and 7 to 10 percent in the 20-Inch Mach 6 Tunnel. A comparison with thin-film measurements using 2-in. radius hemispheres shows the phosphor data to be within 7 percent of thin-film measurements and to agree even better with predictions via LATCH CFD. Good agreement between phosphor data and LAURA CFD computations on the forebody of a vertical takeoff/vertical lander configuration at four angles of attack is also shown. The extrapolation method developed in this report is applied to the X-34 configuration with good agreement between the phosphor extrapolation and LAURA flight surface temperature predictions.

AIAA

Thermography; Phosphors; Data Reduction; Data Processing; Computer Programs; Aerodynamic Heating

19980056178

Application of artificial neural networks to the design of turbomachinery airfoils

Rai, Man M., NASA Ames Research Center, USA; Madavan, Nateri K., NASA Ames Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1003; Copyright; Avail: Aeroplus Dispatch

The feasibility of applying artificial neural networks to aerodynamic design, in particular, the design of turbomachinery airfoils, is investigated. The design process involves defining a target pressure distribution, computing several flows to adequately populate the design space in the vicinity of the target, training the neural network with this data, and, finding a design that has a pressure distribution that is closest to the target. The last step is carried out using the net as a function evaluator. This design process was tested using an established flow simulation methodology, a simple two-layer feedforward network and a conjugate gradient optimization technique. Two-dimensional results are presented for some validation tests as well as a complete design effort where the pressure distribution from a modern Pratt & Whitney turbine was used as a target. These results are very encouraging and clearly warrant further development of the process for full three-dimensional design.

Author (AIAA)

Aircraft Design; Airfoil Profiles; Neural Nets; Turbine Engines; Aerodynamic Characteristics; Feedforward Control

19980056181

A procedural reasoning expert system for CFD

Rodman, Laura C. P., Nielsen Engineering & Research, Inc., USA; Childs, Robert E., Nielsen Engineering & Research, Inc., USA;

Wesley, Leonard P., Intellex, USA; Lee, Janet D., Intellex, USA; Jan. 1998; In English
Contract(s)/Grant(s): F33615-96-C-3006
Report No.(s): AIAA Paper 98-1006; Copyright; Avail: Aeroplus Dispatch

The use of CFD in the design and analysis of flight vehicles requires specialized knowledge about factors such as algorithm options, gridding methods, physical models, and runtime performance. This knowledge is needed to properly set up a calculation and to monitor the solution during execution of the code. The objective of this work is to develop an intelligent software environment that will assist CFD users of all ability levels in setting up and running CFD codes. Procedural reasoning system technology is well-suited for this task, and a prototype system is used to demonstrate various design concepts. The features of the prototype system include an Input Specification Manager for providing guidance during the initialization stage of a calculation, and a Run-time Manager for monitoring and controlling a running CFD calculation. A library of communication modules is used to easily link the expert system with any CFD code. The goal of this system is to facilitate the CFD design/analysis cycle by minimizing the risks associated with improper input parameters, assisting in the early detection of errors, reducing the need for labor intensive manual checks during execution, and improving user training.
Author (AIAA)
Computational Fluid Dynamics; Expert Systems; Flight Vehicles; Computer Aided Design; Run Time (Computers); Aerodynamic Characteristics

19980056186

A fuzzy logic-parity space approach to actuator failure detection and identification

Schram, Gerard, Delft Univ. of Technology, Netherlands; Gopisetty, Sai M., Princeton Univ., USA; Stengel, Robert F., Princeton Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NWO-SIR-13-3919; FAA-95-G-022
Report No.(s): AIAA Paper 98-1014; Copyright; Avail: Aeroplus Dispatch

The integration of fuzzy logic and parity space methodologies is explored for the detection and identification problem of actuator failures of aircraft. Actuator failures are identified in magnitude as bias and scale factor changes. The nonlinear fuzzy logic parity space approach performs accurately over varied flight conditions. The estimated (fuzzy) failure status can directly be used to reconfigure the control system smoothly. The concepts are demonstrated by a simulation example of a nonlinear, six degree-of-freedom civil aircraft model under realistic conditions.
Author (AIAA)
Aircraft Approach Spacing; Actuators; Aircraft Models

19980056455

The development of a tool for semi-automated generation of structured and unstructured grids about isolated rotorcraft blades

Shanmugasundaram, Ramakrishnan, Computer Sciences Corp., USA; Garriz, Javier A., Computer Sciences Corp., USA; Samareh, Jamshid A., Computer Sciences Corp., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The grid generation used to model rotorcraft configurations for CFD analysis is highly complicated and time consuming. The highly complex geometry and irregular shapes encountered in entire rotorcraft configurations are typically modeled using overset grids. Another promising approach is to utilize unstructured grid methods. With either approach the majority of time is spent manually setting up the topology. For less complicated geometries such as isolated rotor blades, less time is obviously required. This paper discusses the capabilities of a tool called Rotor Blade Optimized Topology Organizer and Renderer (ROTOR) being developed to quickly generate block structured grids and unstructured tetrahedral grids about isolated blades. The key algorithm uses individual airfoil sections to construct a NonUniform Rational B-Spline (NURBS) surface representation of the rotor blade. This continuous surface definition can be queried to define the block topology used in constructing a structured mesh around the rotor blade. Alternatively, the surface definition can be used to define the surface patches and grid cell spacing requirements for generating unstructured surface and volume grids. Presently, the primary output for ROTOR is block structured grids using O-H and H-H topologies suitable for full-potential solvers. This paper will discuss the present capabilities of the tool and highlight future work.
Author (AIAA)
Rotor Blades; Grid Generation (Mathematics); Aircraft Configurations; Airfoil Profiles

19980056461

Exploratory study on neural control of rotor noise and hub loads

Kottapalli, Sesi, NASA Ames Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Results from an analytical study on simultaneous neural network control of rotor blade vortex interaction (BVI) noise and hub loads are presented. The present study is an extension of an earlier investigation on neural network identification and control of rotorcraft hub loads. An objective function consisting of the weighted sum of the squares of a four-microphone-average-of-advancing-side-noise and a vibratory-hubloads-metric was used to characterize the BVI noise and vibratory hub loads. The noise and hub loads data were obtained from a wind tunnel test of a four-bladed rotor with individual blade control during simulated descent. A simple iterative procedure for neural control was applied. Two neural networks were used in the procedure requiring a plant model and, separately, an 'inverted neural network for control' model (using a back-propagation neural network). For the basic (benchmark) case, the neural network controller successfully achieved simultaneous reductions of 5 dB in the advancing side noise and 54 percent in the hub loads.
Author (AIAA)
Rotor Blades; Blade-Vortex Interaction; Neural Nets; Hubs; Aerodynamic Loads; Noise Reduction

19980056464
Rotorcraft Noise Model
Lucas, Michael J., Wyle Labs., USA; Marcolini, Michael A., NASA Langley Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch
The Rotorcraft Noise Model (RNM) is an aircraft noise impact modeling computer program being developed for NASA/Langley which calculates sound levels at receiver positions either on a uniform grid or at specific defined locations. The basic computational model calculates a variety of metrics. Acoustic properties of the noise source are defined by two sets of sound pressure hemispheres, each hemisphere being centered on a noise source of the aircraft. One set of sound hemispheres provides the broadband data in the form of one-third octave band sound levels. The other set of sound hemispheres provides narrowband data in the form of pure-tone sound pressure levels and phase. Noise contours on the ground are output graphically or in tabular format, and are suitable for inclusion in environmental impact statements or environmental assessments.
Author (AIAA)
Aircraft Noise; Aircraft Models; Computer Programs; Computational Grids; Sound Pressure

19980057716
Multiobjective optimization and multiple constraint handling with evolutionary algorithms. II - Application example
Fonseca, Carlos M., Sheffield, Univ., UK; Fleming, Peter J., Sheffield, Univ., UK; IEEE Transactions on Systems, Man, and Cybernetics; Jan. 1998; ISSN 1083-4427; Volume 28, no. 1, pp. 38-47; In English; Copyright; Avail: Aeroplus Dispatch
The evolutionary approach to multiple function optimization formulated in the first part of the paper (Fonseca and Fleming, 1998) is applied to the optimization of the low-pressure spool speed governor of a Pegasus gas turbine engine. This study illustrates how a technique such as the multiobjective genetic algorithm can be applied, and exemplifies how design requirements can be refined as the algorithm runs. Several objective functions and associated goals express design concerns in direct form, i.e., as the designer would state them. While such a designer-oriented formulation is very attractive, its practical usefulness depends heavily on the ability to search and optimize cost surfaces in a class much broader than usual, as already provided to a large extent by the genetic algorithm (GA). The two instances of the problem studied demonstrate the need for preference articulation in cases where many and highly competing objectives lead to a nondominated set too large for a finite population to sample effectively. It is shown that only a very small portion of the nondominated set is of practical relevance, which further substantiates the need to supply preference information to the GA.
Author (AIAA)
Gas Turbine Engines; Genetic Algorithms; Engine Design

19980059125
Norbert Wiener and the development of mathematical engineering
Kailath, Thomas, Stanford Univ., USA; Communications, computation, control and signal processing; 1997, pp. 35-64; In English
Contract(s)/Grant(s): F49620-93-1-0085; DAAH04-93-G-0029; Copyright; Avail: Aeroplus Dispatch
An overview of the contributions of Norbert Wiener to the development of mathematical engineering is presented, with emphasis on his efforts to solve the Wiener-Hopf equations encountered in astrophysics. His work on the problem of anti-aircraft fire control is described. His research on the statistical nature of the communication problem is also discussed.
AIAA
Aircraft Structures; Fire Control; Wiener Hopf Equations; Optimal Control

19980059903

Immunized adaptive critics for level 2 intelligent control

KrishnaKumar, K., Alabama, Univ., Tuscaloosa, USA; Neidhoefer, J., Alabama, Univ., Tuscaloosa; 1997, pp. 856-861; In English Contract(s)/Grant(s): NSF ECS-94-15351; NSF ECS-91-13283; Copyright; Avail: Aeroplus Dispatch

Immunized computational systems combine a priori knowledge with the adapting capabilities of immune systems to provide a powerful alternative to currently available techniques for intelligent control. In this paper, we present a perspective on various levels of intelligent control and relate them to similar functioning in human immune systems. A technique for implementing immunized computational systems as adaptive critics is presented and the technique is then applied to a simple 2-DOF control problem as well as a more complex flight path generator for level 2, nonlinear, full-envelope, intelligent aircraft control.
Author (AIAA)

Aircraft Control; Immune Systems; Flight Paths; Artificial Intelligence

19980060353

Application of path planning and visualization for industrial-design and maintainability-analysis

Law, C. C., GE Corporate Research and Development Center, USA; Avila, Lisa S., GE Corporate Research and Development Center, USA; Schroeder, William, GE Corporate Research and Development Center, USA; 1998, pp. 126-131; In English; Copyright; Avail: Aeroplus Dispatch

Software applications Product Vision, and its successor, Galileo, were developed to allow engineers to interactively fly through a digital virtual jet engine, and automatically determine removal paths for maintenance simulations. Three equally significant hurdles have been overcome during the development of this software, with the following results: State-of-the-art algorithms have been developed to find part-removal paths, create swept volumes, and decimate large models for interactive visualization. A powerful yet easy-to-use application has been developed that can efficiently manipulate large data bases. The application has been integrated into many aspects of a large industrial design cycle. The application, Galileo, is being actively used by GE aircraft engines. The visualization and maintainability analysis technology embedded in this software has eliminated the need for costly physical mockups and pushed maintenance issues to the earliest stages of the design cycle. The tool has facilitated concurrent engineering through visually enhanced communications. Most recently, it has been adopted for aiding the assembly of engines, and for training service mechanics.
Author (AIAA)

Product Development; Maintainability; Software Development Tools; Computer Aided Design; Aircraft Engines; Galileo Spacecraft

19980060439

A new simulation methodology for master production scheduling

Davis, Wayne J., Illinois, Univ., Urbana, USA; Brook, Andrew, Illinois, Univ., Urbana; Lee, Michael S., Illinois, Univ., Urbana; 1997, pp. 1808-1813; In English; Copyright; Avail: Aeroplus Dispatch

We describe a new object-oriented simulation methodology that is being developed to support master production scheduling. The paper begins by defining the scheduling problem. We then develop the process plan framework for the simulation. Next, the basic simulation methodology is defined. Finally, directions for future research are briefly outlined.
Author (AIAA)

Computerized Simulation; Methodology; Production Planning; Scheduling; Object-Oriented Programming; Jet Engines

19980061721

Multi-level sampling interval approach to control charts

Vining, G. Geoffrey, Univ. of Florida, USA; Reynolds, Marion R. , Jr.; Journal of Quality Technology; Oct, 1997; ISSN 0022-4065; Volume 29, no. 4, pp. 418-428; In English; Copyright; Avail: Issuing Activity

Whenever one designs a control chart procedure, the proper choice of a sampling interval must reflect the expected time the process is in control before an assignable cause occurs and produces a change in the process. Yet, the expected time in control usually will change over the life of the process. This paper proposes that the proper choice of a sampling interval may be viewed within the context of a multi-level sampling plan. Thus, the sampling interval can be changed to reflect the current state of the process, In so doing, one can maintain the desired statistical properties of the control chart while simultaneously considering the sampling costs involved.
Author (EI)

Approach Control; Process Control (Industry); Statistical Analysis; Complexity; Computer Techniques

19980062153

Static output feedback controllers - Stability and convexity

Geromel, J. C., Campinas, Univ. Estadual, Brazil; de Souza, C. C., Campinas, Univ. Estadual, Brazil; Skelton, R. E., Purdue Univ., USA; IEEE Transactions on Automatic Control; Jan. 1998; ISSN 0018-9286; Volume 43, no. 1, pp. 120-125; In English; Copyright; Avail: Aeroplus Dispatch

The main objective of this paper is to solve the following stabilizing output feedback control problem: given matrices (A, B2, C2) with appropriate dimensions, find (if one exists) a static output feedback gain L such that the closed-loop matrix A-B2LC2 is asymptotically stable. It is known that the existence of L is equivalent to the existence of a positive definite matrix belonging to a convex set such that its inverse belongs to another convex set. Conditions are provided for the convergence of an algorithm which decomposes the determination of the aforementioned matrix in a sequence of convex programs. Hence, this paper provides a new sufficient (but not necessary) condition for the solvability of the above stabilizing output feedback control problem. As a natural extension, we also discuss a simple procedure for the determination of a stabilizing output feedback gain assuring good suboptimal performance with respect to a given quadratic index. Some examples borrowed from the literature are solved to illustrate the theoretical results.

Author (AIAA)

Helicopter Control; Control Stability; Feedback Control; H-2 Control

19980063044

Application of two-varable fuzzy PI control to aeroengine control

Fang, Zhongxiang, Northwestern Polytechnical Univ., China; Huang, Wanwei, Northwestern Polytechnical Univ., China; Li, Huacong, Northwestern Polytechnical Univ., China; Wu, Qihua, Northwestern Polytechnical Univ., China; Zhang, Jiazhen, Northwestern Polytechnical Univ., China; Chen, Fuqun, Northwestern Polytechnical Univ., China; Journal of Aerospace Power; Jan. 1998; ISSN 1000-8055; Volume 13, no. 1, pp. 41-44; In Chinese; Copyright; Avail: Aeroplus Dispatch

A two-variable fuzzy-PI control algorithm based on fuzzy reasoning, and a two-variable fuzzy control algorithm based on fuzzy reasoning with four inputs, are provided. A new two-variable fuzzy-PI controller and the two-variable fuzzy controller with four inputs are developed. Attention is focused on research on those algorithms and the properties of those controllers, as well as their application for aircraft engine control via computer simulation. A new method of engine control is obtained.

Author (AIAA)

Aircraft Engines; Engine Control; Control Systems Design; Computerized Simulation; Proportional Control

19980063875

Adaptive controller for a general class of switched reluctance motor models

Vedagarbha, P., Clemson Univ., USA; Dawson, D. M.; Rhodes, W.; Automatica; Sep, 1997; ISSN 0005-1098; Volume 33, no. 9, pp. 1647-1655; In English; Copyright; Avail: Issuing Activity

In this paper, we utilize a general, nonlinear model of the switched reluctance (SR) motor to develop an adaptive controller for the full-order electromechanical model. The proposed controller requires measurement of the rotor position, rotor velocity, and stator current, does not exhibit any control singularities, achieves global asymptotic position/velocity tracking, and compensates for uncertain electromechanical parameters which are independent of the flux linkage model. to illustrate the generality of the approach, we show how the control can be designed to account for magnetic saturation associated with a proposed flux linkage model. Experimental results are also provided.

Author (EI)

Adaptive Control; Control Equipment; Nonlinear Systems; Mathematical Models; Reluctance; Rotors; Winding

19980065853

Iterative learning identification of aerodynamic drag curve from tracking radar measurements

Chen, Yangquan, Nanyang Technological Univ., Singapore; Wen, Changyun; Dou, Huifang; Sun, Mingxuan; Control Engineering Practice; Nov, 1997; ISSN 0967-0661; Volume 5, no. 11, pp. 1543-1553; In English; Copyright; Avail: Issuing Activity

The aerodynamic drag coefficient curve of spin-stabilized projectiles is very important to the fast generation of accurate firing tables. to identify it from Doppler tracking radar measured velocity data in flight tests, an iterative learning concept (ILC) is applied. High-order ILC algorithms are proposed. Convergence conditions are given in a general problem setting. A 3-DOF point mass trajectory prediction model is proposed. The learning gains, which vary with respect to both time and iteration number, have been used for a faster convergence compared to the constant learning parameter choices. Furthermore, in this paper, a bi-linear

ILC scheme is proposed to produce even faster learning convergence. The flight testing data reduction results of an actual firing practice demonstrate that the iterative learning method is very effective in curve identification.
Author (EI)
Aerodynamic Drag; Tracking Radar; System Identification; Optimal Control; Iterative Solution; Algorithms; Machine Learning; Data Reduction

19980065483
Similarity criteria for manipulator loading and control sensitivity characteristics
Rodchenko, Victor V., TsAGI, Russia; Zaichik, Larisa E., TsAGI, Russia; Yashin, Yury P., TsAGI, Russia; Journal of Guidance, Control, and Dynamics; Apr. 1998; ISSN 0731-5090; Volume 21, no. 2, pp. 307-313; In English; Copyright; Avail: Aeroplus Dispatch

On the basis of similarity-theory methods and the authors' previously developed theoretical approach, similarity criteria are developed for the handling qualities of aircraft with different manipulators and control sensitivity characteristics. The basic concepts are presented for the theoretical approach to estimating the influence of various manipulator and control sensitivity characteristics on handling qualities. The method being substantiated allows estimation of the handling qualities of an aircraft with certain manipulator and control sensitivity characteristics by comparing them with the respective data obtained for the aircraft with other characteristics. Recommendations are given for modeling, on ground-based and in-flight simulators, the controllability of an aircraft with certain manipulators and control sensitivity that may differ from those of simulators. The dynamic characteristics required of the manipulator feel systems used in ground-based and in-flight simulators are considered.
Author (AIAA)
Manipulators; Aircraft Control; Controllability; Similarity Theorem

19980066921
Linear-quadratic-Gaussian controllers with specified parameter robustness
Bryson, Arthur E., Stanford Univ., USA; Mills, Raymond A., TASC, Inc., USA; Journal of Guidance, Control, and Dynamics; Feb. 1998; ISSN 0731-5090; Volume 21, no. 1, pp. 11-18; In English
Report No.(s): AIAA Paper 94-0002; Copyright; Avail: Aeroplus Dispatch

Despite the attractions of linear-quadratic-Gaussian (LQG) controllers, they have had limited acceptance in practice due to lack of knowledge about their robustness to uncertainties in the plant model. A suitable measure of robustness, like the gain margin or the phase margin of classical controllers, was lacking. A new robustness measure, based on the expected parameter deviations from their nominal values, is proposed and used to design robust LQG controllers using nonlinear programming software.
Author (AIAA)
Linear Quadratic Gaussian Control; Robustness (Mathematics); Minimax Technique; Feedback Control; Hovering; Helicopter Control

19980067169
Data analysis with advanced graphics
Poole, Michael R., Transportation Safety Board of Canada, Ottawa, Canada; 1997, pp. 13.1-13.7; In English; Copyright; Avail: Aeroplus Dispatch

This paper attempts to consolidate some of the views that regarding the use of computer graphics for flight recorder analysis that have been expressed by accident investigators over the years, as well as give some of the experiences of the Transportation Safety Board of Canada (TSB) with respect to this subject. The paper also reviews a sample animation in some detail.
Author (AIAA)
Flight Recorders; Computer Graphics; Flight Safety; Computer Animation; Cockpits

19980067608
Honeywell simplifies FMS programming
Proctor, Paul, USA; Aviation Week & Space Technology; Nov. 24, 1997; ISSN 0005-2175; Volume 147, no. 21, pp. 54, 55; In English; Copyright; Avail: Aeroplus Dispatch

The Cockpit Control Language (CCL) currently under development is designed to eliminate the potential for 'mode confusion' by pilots flying aircraft with highly automated cockpits. The ultimate goal of CCL is to change the underlying functionality of flight-management systems to match how the pilot thinks, rather than training the pilot in how the system works.
AIAA
Air Traffic Control; Cockpits; Automation; Flight Management Systems; Automatic Pilots; Software Development Tools

19980067656

COTS initiative and cost of S/W for aging avionics upgrades

Hanna, William A., McDonnell Douglas Aerospace, USA; 1997, pp. 1.1-1 to 1.1-10; In English

Contract(s)/Grant(s): F33615-96-C-1985; Copyright; Avail: Aeroplus Dispatch

Tremendous progress has been made in electronic hardware (H/W) upgrade methodology through the use of reverse engineering and H/W modeling, simulation, and synthesis tools. There are striking similarities between electronic H/W and software (S/W) design methods due to the increasing popularity of modeling and simulation tools in both areas. We attempt to apply successful H/W modeling and simulation methodology to S/W upgrades for achieving affordable fast turn around S/W upgrades. The concepts of OOC/OOD (Object Oriented Coding/Object Oriented Design), S/W Wrappers, S/W Partitioning, and Plug-and-Play are also exploited for fast turnaround and affordable S/W upgrades. A 40-60 percent cost reduction is achievable for both H/W and S/W development, based on the COTS approach and affordability measures. Commonality among platforms can add even more cost savings to both development and long term (20-30 years) maintenance of fielded upgrades based on the proposed methodology. Some of the opinions presented need validation through R&D based on the proposed S/W upgrade methodology.

Author (AIAA)

Cost Analysis; Avionics; Aging (Materials); Reverse Engineering; Cost Reduction

19980067658

Designing for determinism - Lessons learned from modern real-time avionics applications

Preston, J. D. R., Lockheed Martin Tactical Aircraft Systems, USA; Kegley, R. B., Lockheed Martin Tactical Aircraft Systems, USA; 1997, pp. 1.1-19 to 1.1-26; In English; Copyright; Avail: Aeroplus Dispatch

With increasing degrees of integration and application complexity, avionics designers devote considerable attention to structure and form, exploiting the abstraction capabilities of the Ada programming language. Use of design patterns, decomposition, and object construction techniques improve structural understandability and maintainability, but often at the expense of throughput and/or memory utilization. An examination of current design approaches for embedded data processing applications revealed patterns and design mechanisms that significantly reduce temporal determinism. We provide a conceptual overview of the current state of practice within the Ada community by looking at design patterns and temporal mechanisms used in various applications and platforms. Alternative patterns and recommended approaches are developed which provide equivalent structural benefits, while improving determinism resource utilization efficiency.

Author (AIAA)

Real Time Operation; Avionics; Ada (Programming Language)

19980067662

Reconciling avionics database management with security

Roark, Mayford, Lockheed Martin Corp., USA; 1997, pp. 1.2-1 to 1.2-7; In English

Contract(s)/Grant(s): F33615-95-C-1621; Copyright; Avail: Aeroplus Dispatch

New avionics applications such as multisensor data fusion are creating a need for databases which can be accessed and updated in a real-time avionics environment. Conventional database technology is generally inadequate for real-time avionics. The FIRM Program is designing and building a real-time object-oriented DBMS to support such applications. Given the availability of real-time database technology, this paper explores the technical issues of using multilevel security in a real-time avionics database environment. The perceived threat in the airborne environment is contrasted to that of a ground-based environment. After defining the problem and the design choices available, this paper summarizes a flexible approach to be demonstrated by the FIRM Program during Phase IV of its contract. This paper does not address the application of these ideas to specific programs or to security policy in general.

Author (AIAA)

Avionics; Data Bases; Multisensor Fusion; Real Time Operation; Computer Information Security

19980067667

Leveraging an avionics support environment for shared application to multiple platforms

Smith, Kent, USAF, Wright Lab., USA; Miyahara, Gary, Hughes Aircraft Co., USA; 1997, pp. 1.3-9 to 1.3-15; In English; Copyright; Avail: Aeroplus Dispatch

The Advanced Avionics Multi-Radar Software Support Study (AAMRSSS) has evolved an avionics support strategy to leverage support facility resources currently used to support the F-15 Eagle, to also support the AC-130U Gunship. In support of the recommendations of the AAMRSS Study, a second set of studies has been undertaken to develop specific technologies and tools to improve support of the air-to-ground capabilities of the radar avionics. Primarily focused on the system-in-the-loop test and

validation capabilities of the F-15 APG-70 Software Development Facility, technology improvements have been identified for the analog and digital target generators, as well as the incorporation of a playback system for instrumented flight data. These technology improvements have been integrated into the plan for the shared support environment to optimize effective support for the unique capabilities of the AC-130U Gunship. We review the capabilities of the current F-15 APG-70 Software Development Facility, describe the support needs and strategies for a shared multi-platform facility, and summarize the support environment improvements targeted.
Author (AIAA)
Avionics; Software Development Tools; Airborne Radar; Weapon Systems

19980067695

Enhanced fault management for future IMA systems

Wilcock, G. W., Defence Evaluation and Research Agency, UK; 1997, pp. 3.2-32 to 3.2-39; In English; Copyright; Avail: Aeroplus Dispatch

Integrated Modular Avionics (IMA) concepts offer the capability to enhance the reliability and availability of future avionic systems while supporting high performance, flexible deployment and affordability. Fault management is the key to achieving many of the projected benefits, but involves significant technical risk; design entails complex trade-offs, while validation of solutions through testing is only practicable for a small proportion of the possible failure set. System modeling as part of requirements definition and design is essential to achieve optimized solutions with low risk. This paper describes a modeling program initially aimed at exploring the tradeoffs in system architecture and fault management. The approach being taken to extend it to allow for software reliability and fault tolerance is described.
Author (AIAA)
Avionics; Modularity; Systems Integration; Fault Detection; Management Systems

19980067699

Open systems Ada technology demonstration program

Winter, Don C., Boeing Co., USA; Rest, Brian D., Boeing Co., USA; 1997, pp. 3.4-1 to 3.4-7; In English; Copyright; Avail: Aeroplus Dispatch

The Open Systems Ada Technology program is cosponsored by the Ada Joint Program Office, the Open Systems Joint Task Force, and the Joint Strike Fighter Program Office. The flight, of a specially modified AV-8B Harrier, accomplished several key objectives: (1) first known application of the Ada95 programming language to flight software; (2) application of the POSIX commercial standard in a real-time flight software domain; (3) application of commercial hardware, software and development tools to avionics; (4) demonstration and evaluation of object oriented design and mixed programming languages for real-time flight software; and (5) application and evaluation of data error detection/compensation technology developed by Wright Laboratory under the Data Fusion Integrity Process Program. The test profile entailed six releases of Mk-76 practice bombs over China Lake’s Baker Range, using different dive angles and release altitudes. Although accuracy was not an explicit test objective, all six drops were scored as hits under standard accuracy criteria.
Author (AIAA)
Ada (Programming Language); Avionics; Software Development Tools; Real Time Operation; Multisensor Fusion; Software Engineering

19980067704

Using a decision analysis tool for assessing tradeoffs of hardening commercial aircraft against new E3 threats

Devereux, R. W., Veda, Inc., USA; 1997, pp. 4.1-25 to 4.1-32; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents a method for using a software decision analysis tool to study tradeoffs and risk analysis in the airline industry. The decision to install threat mitigation techniques aboard commercial aircraft against RF electromagnetic transmitters was analyzed against the airline’s financial risk of not installing these devices and risking the loss of aircraft and passengers.
Author (AIAA)
Decision Making; Tradeoffs; Commercial Aircraft; Software Development Tools

19980067717

The application of failure mode and effect analysis for software in digital fly control systems

Hao, Chunping, China; Li, Peiqiong; Yao, Yiping; 1997, pp. 4.4-8 to 4.4-13; In English; Copyright; Avail: Aeroplus Dispatch

This paper describes an automated analysis method and software package tool for critical software, the SFMEA (Software Failure Mode Effect Analysis) system, as well as its application in digital flight control systems. This package is developed on

the basis of a combination of advanced matrix techniques and traditional tabular methods. When performed in an accurate and timely fashion, SFMEA can be an invaluable source of information for the design of test systems, the development of trouble-shooting procedures, the planning of scheduled maintenance, and the examination of software systems' strengths and weaknesses. As a qualitative resource, SFMEA can be extended to cover complete or partial software systems. As an example, we perform an analysis of a digital flight control system with the method.
Author (AIAA)
Failure Modes; Numerical Control; Flight Control; Software Development Tools

19980067729

Object request broker software technology - Applications in an advanced open systems avionics architecture

Pedersen, Robert, Computing Devices International, USA; 1997, pp. 5.2-18 to 5.2-25; In English; Copyright; Avail: Aeroplus Dispatch

The use of commercial off-the-shelf (COTS) hardware elements for avionics systems has become both attractive and potentially highly rewarding in recent times. A number of programs are underway to validate approaches and demonstrate applicability. A different situation exists with respect to software. The use of COTS software for avionics applications lags far behind that of hardware. However, the rise of 'Object Request Broker' (ORB) concepts for network communications may change matters. This paper documents experience with the use of ORB technology as the basis for open system communications within an advanced avionics architecture driven toward software portability and machine independence of functions. The paper describes the conceptual approach to using ORBs in this context, and initial results in the first series of implementation and demonstration tests.
Author (AIAA)
Software Engineering; Avionics

19980067736

Maritime avionics subsystems and technologies - Advanced Graphics and Data Fusion

Adagio, Floyd, Cambridge Research Associates, USA; Babiak, Nicholas, Cambridge Research Associates, USA; Bollinger, Kenneth, Defence Micro-Electronic Activity, USA; Caposell, Charles, U.S. Navy, Naval Air Systems Command, USA; 1997, pp. 5.4-16 to 5.4-21; In English; Copyright; Avail: Aeroplus Dispatch

The Advanced Graphics and Data Fusion component of the Maritime Avionics Subsystems and Technologies (MAST) program are intended to extend the limits of present visualization capabilities to support technology insertion into present and future Naval air assets. These requirements will include information fusion and rendering to support in-flight retasking and retargeting. The requirements of such airborne applications provide a more stringent temporal/spatial resolution and accuracy than those of surface, subsurface, and/or ground situation; airborne applications by nature require low latency and high accuracy information due to tactics and operations. This is particularly true within stressing mission profiles and conservative rules of engagement. to a user, information formats and presentation are constrained by system and cost considerations. We discuss the application of virtual, visualization environments within a hierarchical requirements structure based on war fighting functional requirements. Additionally, functional requirements are related to MAST system characteristics and utility to airborne applications are also discussed.
Author (AIAA)
Avionics; Multisensor Fusion; Computer Graphics; Navy

19980067731

Learning attributes for situational awareness in the landing of an autonomous airplane

Blasch, Erik P., USAF, Wright Lab., Wright-Patterson AFB, OH; Wisconsin, Univ., Madison, USA; 1997, pp. 5.3-1 to 5.3-8; In English; Copyright; Avail: Aeroplus Dispatch

The paper investigates situational learning (SL), which uses probability and evidential theory to determine the importance of environmental cues as they contribute to situational awareness. The situation-awareness agent's goal is consistent with that of an aircraft pilot; namely, to land a plane under a variety of weather and runway conditions. Landing requires hypothesis selection which can be formulated as a situational-learning problem in which sensed states are represented as current situational beliefs. The objective of SL is to learn how to select the optimal set of mutually nonexclusive hypotheses in order to maximize the identification of the situation. Three methodologies for the combination of sensor measurements for situational learning are designed and analyzed for a system equipped with a position-measuring device and identification sensors. Using a learning algorithm for searching, the a priori identification probabilities of recognition are known. The methods are (1) recursive Bayesian where the probability of the current state is based on the a priori information multiplied by the likelihood function, (2) Dempster-Shafer,

which uses evidential reasoning/accrual to combine information of uncertainty, and (3) Modified Dempster-Shafer, using a combination of evidential reasoning and probability. The methods are assessed for cases with and without feedback.
Author (AIAA)
Aircraft Landing; Autonomy; Aircraft Pilots

19980067753

A process direction for common avionics developments using commercial hardware and software components - The avionics systems engineering challenge

Kuehl, C. S., Logicon RDA, Inc., USA; 1997, pp. 6.4-1 to 6.4-9; In English; Copyright; Avail: Aeroplus Dispatch

Moving from traditional military avionics development to commercial-off-the-shelf (COTS) development imposes an embedded computer-based systems engineering challenge to avionics equipment manufacturers and aircraft platform integrators. to successfully adopt this shift in avionics acquisition strategy, a practical (tailorable) systems engineering process must exist in both the avionics manufacturing and aircraft integration business sectors to provide a catalyst for 'value-engineering' management. Emerging systems engineering (SE) standards concentrate heavily on the 'essential' detailed engineering management process perspectives associated with the development of large-scale avionics systems (i.e., a process of architecting a large system comprised of smaller complex subsystems). After a discussion of present day COTS procurement topics, this paper focuses on how to use key hardware and software COTS-enhancing process ingredients with emerging SE process standards to attain life cycle 'value engineering' during common military avionics procurements.
Author (AIAA)
Avionics; Software Development Tools; Systems Engineering

19980067865

Global far-field computational boundary conditions for C- and O-grid topologies

Verhoff, A., McDonnell Douglas Corp., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 148-156; In English
Contract(s)/Grant(s): F33615-94-C-3000; Copyright; Avail: Aeroplus Dispatch

Global far-field computational boundary conditions for inviscid external flow problems have been developed for C- and O-grid topologies. This analysis represents a unified approach for two-dimensional external flow problems. These boundary conditions are derived from analytic solutions of an asymptotic form of the steady-state Euler equations and have improved accuracy compared to characteristic boundary conditions commonly used in practice. The Euler equations are asymptotically linearized about a constant-pressure rectilinear flow condition, which is the true boundary condition at infinity. Previous work had developed higher-order boundary conditions for C-grid topologies by assuming small perturbations in both pressure and flow direction at and beyond the computational boundary, by decoupling the inflow and outflow analyses, and by linearizing the thermodynamic relations. This work lifts these restrictions, although some higher-order compressibility effects are neglected. It is based on a global mapping of the boundary and the solution of the resulting Dirichlet-Neumann problem. Because the Euler equations are used to develop the boundary conditions, the flow crossing the boundary can be rotational. The boundary conditions can be used with any numerical Euler solution method and allow computational boundaries to be located very close to the nonlinear region of interest. This leads to a significant reduction in the number of grid points required for numerical solution. Numerical results are presented that show that the boundary conditions and far-field analytic solutions provide a smooth transition across a computational boundary to the true far-field conditions at infinity. They also demonstrate the synergism that can be realized from coupling analytic and computational methods.
Author (AIAA)
Computational Fluid Dynamics; Boundary Conditions; Topology; Airfoils; Two Dimensional Flow; Computational Grids

19980067876

Neural-network-based controller for nonlinear aeroelastic system

Ku, C.-S., Rensselaer Polytechnic Inst., USA; Hajela, P., Rensselaer Polytechnic Inst., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 249-255; In English
Contract(s)/Grant(s): DAAH04-93-G-0003; Copyright; Avail: Aeroplus Dispatch

Attenuation of vibratory response is an important design consideration in many aeroelastic systems, and active methods of vibration reduction have been studied extensively in this context. Synthesis of active controllers requires that a good analytical model of the system be available. In those problems in which the aeroelastic system is inherently nonlinear, a robust control scheme is difficult to implement, particularly in the presence of large uncertainties in the model. The use of artificial neural networks, with on-line learning capabilities, is explored as an approach for developing robust control strategies for such problems.

In particular, the use of neural networks to mimic the behavior of a linear quadratic Gaussian controller that is applicable to nonlinear systems is presented. The helicopter rotor blade is a classic example of an aeroelastic system in which vibration reduction is an overriding concern, and in which the plant is both nonlinear and contains uncertainties. A simplified two-dimensional representation of this aeroelastic system, consisting of an airfoil with a trailing-edge control flap, is considered as a test case in the present work; both structural and aerodynamic nonlinearities are included in the problem.
Author (AIAA)
Neural Nets; Nonlinear Systems; Aeroelasticity; Vibration Damping; Rotary Wings

19980067881

Interfacing of fluid and structural models via innovative structural boundary element method

Chen, P. C., Zona Technology, Inc., USA; Jadic, I., Zona Technology, Inc., USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 282-287; In English; Copyright; Avail: Aeroplus Dispatch

An innovative structural boundary element method (BEM) solver is developed for interfacing the computational fluid dynamics (CFD) and computational structural dynamics (CSD) grids. Formulated as a solid mechanics problem with a minimum strain energy requirement, the BEM solver generates a truly three-dimensional universal spline matrix. The universal spline matrix is a vector operator that includes the coupling of displacements and forces along all axes. Based on a similar formulation, an exterior BEM solver is also developed to account for the flowfield grid deformation. Thus, the BEM solver allows a unified treatment of the displacement and force transformation for CFD/CSD interfacing, as well as the computation of the flowfield grid deformation. The solution procedure is fully automated, and no additional model generation is required; therefore, it is ideally suitable for computational aeroelasticity and multidisciplinary optimization applications.
Author (AIAA)
Boundary Element Method; Computational Fluid Dynamics; Dynamic Structural Analysis; Aeroelasticity

19980068652

Image gray-level rectifying in scene matching

Ly, Tieying, Huazhong Univ. of Science and Technology, China; Peng, Jiaxiong, Huazhong Univ. of Science and Technology, China; 1997, pp. 141-153; In English; Copyright; Avail: Aeroplus Dispatch

The main problem in scene-matching is the differences between multisensor images, such as resolution difference and gray-level difference, which make it very difficult to register two images. This paper describes statistical properties and an autocorrelation model for the gray-level difference between these images to attempt to rectify the gray-level of a sensed image to solve the problem. Supposing the gray-level difference is an ergodic wide-sense stationary 2D random field with zero mean value in a local region, the autocorrelation model of the gray-level difference is studied to identify a linear system through which the simulated difference distribution is acquired to rectify the gray-level of sensed image. After being rectified, the gray-level of the sensed image and reference image will be simillar, so that their registration is much easier. Tbe validity of this method is verified by the experiment results with several pairs of aerial image (sensed image) and satellite image (reference image).
Author (AIAA)
Gray Scale; Scene Analysis; Rectification; Aircraft Guidance; Image Processing

19980068879

PC-based stereo visualization tools for aviation virtual reality projects

Stepanov, Alexander A., State Research Inst. of Aviation Systems, Russia; Zheltov, Sergei Y., State Research Inst. of Aviation Systems, Russia; Kiryakov, Konstantin R., IBIK, Ltd., Russia; Invalev, Alexander I., IBIK, Ltd., Russia; Boltunov, Anatoly V., IBIK, Ltd., Russia; 1997, pp. 328-335; In English; Copyright; Avail: Aeroplus Dispatch

An investigation of technical and programming tools for stereo visualization of highly accurate and detailed 3D models of objects and the terrain with geo-specifically placed objects like buildings, roads, forests and other special landmarks are discussed. Hardware includes liquid crystal shutter glasses and an Intel Pentium computer with monitor. Use of original photogrammetric and rendering software under MS Windows provides very realistic ’walk-through’ and ’fly-over’ simulations. These tools are cheaper than ones oriented to powerful workstations. Examples of animations and virtual spaces with 3D site models of real scenes designed for airplane pilot training are given.
Author (AIAA)
Virtual Reality; Personal Computers; Stereoscopic Vision; Three Dimensional Models; Software Development Tools; Aircraft Pilots

19980068951

Computational issues in alternating projection algorithms for fixed-order control design

Beran, Eric, Technical Univ. of Denmark, Lyngby, Denmark; Grigoriadis, Karolos M., Houston, Univ., USA; 1997, pp. 81-85; In English; Copyright; Avail: Aeroplus Dispatch

Alternating projection algorithms have been introduced recently to solve fixed-order controller design problems described by linear matrix inequalities and nonconvex coupling rank constraints. In this work, extensive numerical experimentation using proposed benchmark fixed-order control design examples is used to indicate the computational efficiency of the method. These results indicate that the proposed alternating projections are effective in obtaining low-order controllers for small- and medium-order problems.

Author (AIAA)

H-Infinity Control; Control Systems Design; Computer Programming; Feedback Control; Helicopter Control

19980068957

A combined MBPC/H-infinity automatic pilot for a civil aircraft

Papageorgiou, George, Cambridge, Univ., UK; Huzmezan, Mihai, Cambridge, Univ., UK; Glover, Keith, Cambridge, Univ., UK; Maciejowski, Jan, Cambridge, Univ., UK; 1997, pp. 118-122; In English; Copyright; Avail: Aeroplus Dispatch

This paper motivates the combined use of H-infinity loop-shaping and model-based predictive control (MBPC) as a method for designing automatic pilots for civil aircraft. The H-infinity loop-shaping controller will provide stability augmentation and guidance. The MBPC controller will act as a flight manager. The design procedure developed was tested by designing an autopilot for the Research Civil Aircraft Model (RCAM) used in the GARTEUR design challenge. The resulting controller was subjected to a standard evaluation procedure. Satisfactory results were achieved.

Author (AIAA)

Automatic Pilots; H-Infinity Control; Control Systems Design; Flight Control

19980068990

Optimal nonlinear robust control for nonlinear uncertain cascade systems

Haddad, W. M., Georgia Inst. of Technology, Atlanta, USA; Chellaboina, V. S., Georgia Inst. of Technology, Atlanta; Fausz, J. L., Georgia Inst. of Technology, Atlanta; Leonessa, A., Georgia Inst. of Technology, Atlanta; 1997, pp. 403-407; In English

Contract(s)/Grant(s): NSF ECS-94-96249; DAAH04-96-1-0008; F49620-96-1-0125; Copyright; Avail: Aeroplus Dispatch

We develop an optimality-based robust control framework for uncertain cascade systems with structured parametric uncertainty. Specifically, using an optimal nonlinear robust control framework, we develop a family of globally stabilizing robust backstepping controllers parametrized by the cost functional that is minimized. It is also shown that the robust control Liapunov function guaranteeing closed-loop stability over a prescribed range of structured system parametric uncertainty is a solution to the steady-state Hamilton-Jacobi-Bellman equation for the controlled system and thus guarantees robust stability and robust performance. The results are then used to design robust controllers for jet engine compression systems with uncertain compressor characteristic performance maps.

Author (AIAA)

Jet Engines; Optimal Control; Cascade Control

19980068996

Optimal nonlinear disturbance rejection control for nonlinear cascade systems

Haddad, Wassim M., Georgia Inst. of Technology, Atlanta, USA; Chellaboina, Vijaya-Sekhar, Georgia Inst. of Technology, Atlanta; Fausz, Jerry L., Georgia Inst. of Technology, Atlanta; 1997, pp. 448-452; In English

Contract(s)/Grant(s): NSF ECS-94-96249; DAAH04-96-1-0008; F49620-96-1-0125; Copyright; Avail: Aeroplus Dispatch

We develop an optimality-based disturbance rejection control framework for nonlinear cascade systems with bounded energy (square-integrable) L2 disturbances. Specifically, using a nonlinear-nonquadratic disturbance rejection optimal control framework, we develop a family of globally stabilizing generalized backstepping controllers parameterized by the cost functional that is minimized. It is also shown that the control Liapunov function guaranteeing closed-loop stability is a solution to the steady-state Hamilton-Jacobi-Bellman equation for the controlled system and thus guarantees both optimality and stability. In addition, the resulting optimal controller guarantees that the closed-loop system is nonexpansive (gain-bounded). The results are then used to design disturbance rejection controllers for jet engine compression systems with bounded energy L2 disturbances.

Author (AIAA)

Rotating Stalls; Optimal Control; Disturbing Functions; Cascade Control; Jet Engines

19980069021

Neural control of the NASA Langley 16-Foot Transonic Tunnel

Motter, Mark A., NASA Langley Research Center, USA; Principe, Jose C., Florida, Univ., Gainesville; 1997, pp. 662, 663; In English

Contract(s)/Grant(s): NSF ECS-95-10715; Copyright; Avail: Aeroplus Dispatch

Experimental results of controlling the Mach number in a transonic wind tunnel with a system of artificial neural networks are presented. Kohonen self-organizing maps are used to cluster the local tunnel dynamics and thereby predict the Mach number response to candidate control input sequences. The sequence minimizing the predicted error between the desired and actual Mach number is applied to the tunnel fan drive system. Comparison is made to gain scheduled automatic control currently in use.

Author (AIAA)

Transonic Wind Tunnels; Neural Nets; Wind Tunnel Drives; Linear Prediction; Controllers

19980069232

Disturbance attenuation for systems with real parametric uncertainty

Kose, I. E., California, Univ., Irvine, USA; Jabbari, Faryar, California, Univ., Irvine; 1997, pp. 2198-2202; In English

Contract(s)/Grant(s): NSF BCS-93-02102; Copyright; Avail: Aeroplus Dispatch

We discuss the problem of parameter-independent controller synthesis to provide quadratic stability and a desirable disturbance attenuation level (through an appropriately small L2 gain) for systems with time-varying, real parametric uncertainty. Through the use of skew symmetric matrices, the conservatism of the standard scaled H-infinity approach is reduced. While the full state feedback problem is convex, the output feedback problem is not. A set of conditions under which the design of output feedback controllers can be broken into two sequential convex problems is presented. The results are compared with recent results in design of parameter-varying controllers and a simple result regarding the mixed problem (where some of the unknown parameters can be measured on line) is discussed. An example is presented to illustrate the proposed approach.

Author (AIAA)

Helicopter Control; Control Systems Design; Control Stability

19980069253

The decentralized fixed modes of twin lift systems

Huang, Shoudong, Northeastern Univ., China; Yang, Guanghong, Northeastern Univ., China; Jing, Yuanwei, Northeastern Univ., China; Zhang, Siying, Northeastern Univ., China; 1997, pp. 2388, 2389; In English; Copyright; Avail: Aeroplus Dispatch

A type of system found in various problems in aerospace technology is studied. Emphasis is on twin lift systems. Because of the special structure of these systems, their controllability, observability, stability, and existence of decentralized fixed modes can be tested on lower-order matrices. The same conclusion holds true for circulant composite systems.

Author (AIAA)

Helicopters; Aerodynamic Loads; Aerospace Engineering; Controllability

19980069277

Robust control of non-passive systems via passification

Kelkar, A. G., Kansas State Univ., Manhattan, USA; Joshi, S. M., NASA Langley Research Center, USA; 1997, pp. 2657-2661; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents methods which enable the use of passivity-based control design techniques to control non-passive systems. For inherently non-passive finite-dimensional linear time-invariant systems, passification methods are presented to render such systems passive by suitable compensation. The passified system can then be controlled by a class of passive linear controllers. The idea is to exploit the robust stability properties of passivity-based control laws for uncertain systems. The proposed passification methods are demonstrated by application to the ACC benchmark problem and to pitch-axis control of an F-18 High Alpha Research Vehicle (HARV) model.

Author (AIAA)

Control Systems Design; F-18 Aircraft; Aircraft Control; Research Aircraft

19980069416

A two-time-scale controller for a differentially cross-coupled system

Mullhaupt, P., Lausanne, Ecole Polytechnique Federale, Switzerland; Srinivasan, B., Lausanne, Ecole Polytechnique Federale, Switzerland; Bonvin, D., Lausanne, Ecole Polytechnique Federale, Switzerland; 1997, pp. 3839-3841; In English; Copyright; Avail: Aeroplus Dispatch

Control of underactuated mechanical systems often leads to unstable internal dynamics, which can be handled by resorting to prediction when the system bandwidth is small. The present paper considers systems with a high bandwidth and proposes a two-time-scale controller for decoupling the system while ensuring internal stability. A toy helicopter in which the speed of the propellers is manipulated to vary the aerodynamic force is used as a case study.
Author (AIAA)
Controllers; Mechanical Devices; Systems Stability; Helicopters

19980070152

Selecting the weight coefficients of integral quadratic estimates when determining the optimal characteristic polynomials
O vybore vesovykh koehffitsientov integral'nykh kvadratichnykh otsenok pri opredelenii optimal'nykh kharakteristicheskikh polinomov

Romanenko, L. G., Kazanskij Gosudarstvennyj Tekhnicheskij Univ.-KAI, Russia; Aviatsionnaya Tekhnika; 1997; ISSN 0579-2975, no. 2, pp. 33-40; In Russian; Copyright; Avail: Aeroplus Dispatch

Mathematically based recommendations are presented for selecting the weight coefficients of integral quadratic estimates in problems of searching for characteristic polynomials whose coefficients minimize the integral quadratic estimates. The approach proposed here is illustrated for the case of the horizontal motion of an aircraft with an autopilot.
AIAA
Flight Control; Integral Equations; Weighting Functions; Quadratic Equations; Polynomials; Optimal Control

19980071991

A simplified scheme for scheduling multivariable controllers

Garg, Sanjay, NASA Lewis Research Center, USA; IEEE Control Systems Magazine; Aug. 1997; ISSN 0272-1708; Volume 17, no. 4, pp. 24-30; In English; Copyright; Avail: Aeroplus Dispatch

A simplified scheme for scheduling multivariable controllers for robust performance over a wide range of plant operating points is presented. The approach consists of scheduling only the output matrix of a dynamic controller, thus significantly reducing the number of parameters to be scheduled. The approach starts with a given robust controller at a nominal design point designed such that it gives a stable closed-loop system at various off-design operating points. The parameters of the controller output matrix are then optimized such that the closed-loop response at the off-design points closely matches the design point closed-loop response. The optimization problem formulation for the synthesis of controller scheduling gains is discussed. Results are presented for controller scheduling for a turbofan engine for a conceptual short take-off and vertical landing aircraft. The simplified controller scheduling is shown to provide satisfactory response for engine models corresponding to significant gross thrust variations from the nominal design point.
Author (AIAA)
Multivariable Control; Controllers; Turbofan Engines; Control Systems Design; Loop Transfer Functions

19980072150

New source-term correction method in a 3-D elliptic grid generation

Zhang, Zhengke, Beijing Univ. of Aeronautics and Astronautics, China; Zhu, Ziqiang, Beijing Univ. of Aeronautics and Astronautics, China; Zhuang, Fenggan, Beijing Univ. of Aeronautics and Astronautics, China; Luo, Shijun, Northwestern Polytechnical Univ., China; Beijing University of Aeronautics and Astronautics, Journal; Aug. 1997; ISSN 1001-5965; Volume 23, no. 4, pp. 452-455; In Chinese; Copyright; Avail: Aeroplus Dispatch

A new source-term correction method is presented for 3-D elliptic grid generation. The grid generated by the new method can be made orthogonal to one specified family of boundaries, and the spacings of the first-layer grid points off the boundaries can be controlled to equal an expected distribution. A C-O type grid for a delta wing is generated as an example.
Author (AIAA)
Grid Generation (Mathematics); Correction; Delta Wings; Elliptic Differential Equations

19980072292

Lockheed Martin develops virtual reality tools for JSF

Mecham, Michael, USA; Aviation Week & Space Technology; Oct. 06, 1997; ISSN 0005-2175; Volume 147, no. 14, pp. 51-53; In English; Copyright; Avail: Aeroplus Dispatch

Lockheed Martin has begun a Virtual Product Development Initiative for the Joint Strike Fighter to develop the best combat design and to reduce operations and maintenance costs. The multidisciplinary team approach to the software design is discussed.
AIAA
Virtual Reality; Fighter Aircraft; Lockheed Aircraft; Product Development

19980072336
Parameterizing a metric of midair collision risk
Knecht, William R., Minnesota, Univ., Minneapolis, USA; Hancock, Peter A., Minnesota, Univ., Minneapolis; 1997, pp. 9-12; In English
Contract(s)/Grant(s): FAA-93-G-048; Copyright; Avail: Aeroplus Dispatch

A nonlinear mathematical collision risk modeling function previously proposed is here further evaluated. The function estimates probability of midair aircraft collision as a function of time to contact. The function yields an S-shaped performance curve (psychometric function) for collision risk. The function is evaluated by curve fitting to flight simulator data in simulated conflict scenarios.
Author (AIAA)
Midair Collisions; Parameterization; Mathematical Models; Aircraft Accidents; Probability Distribution Functions; Psychometrics

19980072352
Systems theory implications for human factors in aviation
McKinney, Earl H., Jr., U.S. Air Force Academy, USA; 1997, pp. 85-89; In English; Copyright; Avail: Aeroplus Dispatch

Systems theory is presented as a complement to the more traditional scientific approaches in aviation science. Tenets of systems theory are contrasted with traditional approaches that employ reductionism. A complementary method of inquiry using groups or organizations as the unit of analysis is systems theory, a framework long fundamental to human factors but treated with curious ambivalence by practitioners (Meister, 1989). This integrative perspective has matured to a point that warrants serious consideration. Four variations in systems theory are compared, and the applications of each are made to aviation science. The limitations of systems theories are presented, as well as current and potential applications of systems theory to aviation science.
Author (AIAA)
Human Factors Engineering; Aeronautics; Systems Analysis; Man Machine Systems

19980072586
On retaining the fairly good performance of a flight vehicle in case of partial actuator failure
Hu, Changhua, Xian Research Inst. of High Tech, China; Chen, Xinhai, Northwestern Polytechnical Univ., China; Northwestern Polytechnical University, Journal; Nov. 1997; ISSN 1000-2758; Volume 15, no. 4, pp. 563-569; In Chinese; Copyright; Avail: Aeroplus Dispatch

Technical information has been sought in the open literature on how to keep a flight vehicle working when partial actuator failure occurs. We find it possible to meet China's needs better by using a fault-tolerant controller designed by us to keep the performance of such a flight vehicle fairly good. The heart of the principles underlying the fault-tolerant controller designed by us is a theorem that is proved here. We took as an example for numerical simulation the attitude control system of a certain type of Chinese flight vehicle. Numerical simulation results clearly show that fairly good stability is retained. Furthermore, on the basis of simulation calculations, we computed the closed-loop system performance H-infinity norm bound to be 2.890. All this appears to confirm that fairly good performance is retained even when partial actuator failure occurs.
Author (AIAA)
Fault Tolerance; Failure Analysis; Flight Vehicles; H-Infinity Control

19980072594
Modeling software for reducing crash-related deaths and injuries
Aerospace Engineering; Dec. 1997; ISSN 0736-2536; Volume 17,, no. 12, pp. 20, 21; In English; Copyright; Avail: Aeroplus Dispatch

Traditional helicopter restraint harnesses, designed to maximize pilot or crew members' safety in the cockpit, are often restrictive and, as a result, are often loosened to gain comfort and mobility. In the event of a crash, a loosened restraint system compromises occupant safety. to address this problem, the U.S. Department of Defense awarded Advanced Structures Technology, Inc. (AST) of Phoenix, AZ, a contract to design a helicopter crew member pretensioning device (PTD). The PTD enables pilots and crew members to wear restraint systems comfortably until a crash onset, when it automatically tightens around the occupant to

reduce injury or improve the chance of survival. Since two-thirds of helicopter crash-related injuries and deaths are due to upper torso flailing, AST engineers defined the occupant 'flail envelope' by using a Working Model dynamic analysis software from Knowledge Revolution. A description of the model is given, and the subsequent PTD design resulting from this model is briefly explained.
AIAA
Software Development Tools; Aircraft Accidents; Death; Crash Injuries; Helicopter Performance

19980072728

Using response surface methodology in fuzzy set based design optimization

Venter, Gerhard, Florida, Univ., Gainesville, USA; Haftka, Raphael T., Florida, Univ., Gainesville; 1998, pp. 641-652; In English
Contract(s)/Grant(s): NAG1-1669
Report No.(s): AIAA Paper 98-1776; Copyright; Avail: AIAA Dispatch

The use of fuzzy set theory to model uncertainties in the aircraft industry associated with design with novel materials is discussed. The design problem involves maximizing the safety level of a structure for a fixed weight budget, where the structure will be built from materials not yet available. The uncertainty is described on the basis of expert opinion and assumptions. A response surface methodology is used in the design process described, to reduce the computational burden associated with designing for uncertainty. Response surface methodology is also used to integrate the analysis code with the optimization algorithm and to eliminate numerical noise, which is inherent to the response function. The elimination of noise in the response function allows the use of a derivative-based optimization algorithm. An isotropic plate with a change in thickness across its width is considered as a design problem. All problem parameters are uncertain, and both yield stress and buckling load failure criteria are considered. The optimum design obtained from fuzzy set theory is compared to a traditional deterministic design, which uses a safety factor to account for the uncertainty. The fuzzy set based design is superior to the equivalent deterministic design. Also, substantial savings in computational cost are realized via response surface methodology in the design process.
Author (AIAA)
Fuzzy Sets; Aircraft Design; Methodology; Optimization; Aircraft Industry

19980072779

Applied Neural Networks for predicting approximate structural response behavior using learning and design experience

Nagendra, S., General Electric Co., USA; Laflen, J., GE Aircraft Engines, USA; Wafa, A., General Electric Co., USA; 1998, pp. 1162-1171; In English
Report No.(s): AIAA Paper 98-1832; Copyright; Avail: AIAA Dispatch

Neural Networks are a class of synergistic computational paradigms that can be distinguished from others by their inherent fine grain parallelism, distributed adaptation and biological inspiration. Neural Networks offer solutions to problems that are very difficult to solve using traditional algorithmic decomposition techniques, and the potential benefits of neural nets are: learning from the interaction with the environment, few restrictions on the functional relationships, and an inherent ability to generalize training information to similar situations and inherently ensure parallel design and load distribution. While the initial motivation for developing artificial neural nets was to develop computer models that could imitate certain brain functions, neural nets can be thought of as mathematically developing nonlinear response surfaces. In the present study all the above aspects of neural nets are estimated and evaluated in a practical industry application of estimating the multimodal frequencies of high pressure turbine blades of different families of aircraft engines.
Author (AIAA)
Neural Nets; Structural Design; Modal Response; Turbine Blades; Aircraft Engines

19980072923

Perturbation method in condensation for eigenproblems

Kim, Ki-Ook, Inha Univ., Republic of Korea; 1998, pp. 2601-2608; In English
Report No.(s): AIAA Paper 98-2018; Copyright; Avail: AIAA Dispatch

An analytical method is presented to improve the eigensolution obtained through system condensation. The perturbation method is based on a correction of the conventional transformation, which differs from mode to mode. The formulation is simple and straightforward. The condensation error, which is unavoidable in the usual transformation, can be reduced noticeably. When the series expansion in the transformation correction is converging, the method should approach the exact eigenvalue from above. In linear formulations, however, the error in dropping higher-order terms of the perturbation equation may cause the approximation to overshoot the exact solution. The improved mode shape can be obtained, especially when integrated reduction methods

are employed to obtain more accurate eigenmodes. It is recommended that the perturbation method be applied as a supplementary step of condensation to improve the eigensolution.
Author (AIAA)
Perturbation Theory; Eigenvalues; Data Reduction; Tail Assemblies; Helicopters; Cantilever Beams

19980073018
Physical programming - Intra-criteria and inter-criteria preference in design optimization
Messac, Achille, Northeastern Univ., USA; Apr. 1998; In English
Contract(s)/Grant(s): NSF DMI-97-02248
Report No.(s): AIAA Paper 98-1970; Copyright; Avail: AIAA Dispatch

This paper addresses a critical component of design optimization that is arguably at its infancy. The design optimization process may be viewed as comprising three generic phases. In the first, we model the physical system, and form a set of design metrics in terms of design variables. In the second, we quantify the overall design objective by forming an aggregate objective function in terms of the design metrics. In the third, we optimize the aggregate objective function using an optimization code. The physical programming method is intended to address the shortcomings of phase two. The current development stage of physical programming allows for the explicit prescription of intra-criteria preference. This paper builds on previous developments to also address inter-criteria preference in design optimization. The general subject of designer preference is discussed. A numerical example is provided within the framework of a graphical user interface that facilitates the designer's preference-setting decision-making process.
Author (AIAA)
Computer Programming; Graphical User Interface; Decision Making; Computer Aided Design; Aircraft Design

16
PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19980049750
Thermal management of an avionics module using solid-liquid phase-change materials
Pal, Debabrata, Motorola, Inc., USA; Joshi, Yogendra K., Maryland, Univ., College Park; Journal of Thermophysics and Heat Transfer; Jun. 1998; ISSN 0887-8722; Volume 12, no. 2, pp. 256-262; In English; Copyright; Avail: Aeroplus Dispatch

A combined experimental and computational investigation of transient thermal control of an avionics module using phase-change material (PCM) is reported. The configuration examined was a honeycomb core filled with an organic PCM, n-triacontane, heated from the bottom. Experiments were conducted to evaluate the thermal performance of the PCM device by measuring temperatures at various locations as functions of time until the module temperature reached an acceptable maximum limit. An analysis of melting inside a single honeycomb cell, considering effects of natural convection, showed that, for the power levels and the cell geometry considered, the effect of natural convection on melting was negligible. A system-level analysis of the PCM-filled device followed. Timewise variations of temperatures at various locations from the model were in good agreement with the experimental data. Times for complete melting, maximum temperature variations within the honeycomb, and evolution of melt shapes are presented as functions of power levels.
Author (AIAA)
Avionics; Phase Change Materials

19980049821
An efficient Kirchhoff integration method for rotor noise prediction starting indifferently from subsonically or supersonically rotating meshes
Rahier, G., ONERA, France; Prieur, J., ONERA, France; ONERA, TP no. 1997-48; 1997; In English
Report No.(s): ONERA, TP no. 1997-48; Copyright; Avail: Aeroplus Dispatch

An original implementation of the Kirchhoff method which uses subsonically as well as supersonically rotating CFD grids for integration on a fixed axisymmetrical Kirchhoff surface is presented. The formulation is written for a propagation medium either at rest or in uniform translation. The particular time-integration technique, which considers each grid element as acoustically non-compact, is described in detail. It does not require solving the retarded time equation since it starts from the emission time, and a regular grid is not necessary. Numerical tests show the capability of the method to work well even with relatively wide sur-

face elements and large emission time steps. The code KIM based on this integration technique is validated by comparisons with analytical calculations in the case of a rotating point dipole. KIM is also applied to the UH-1H model rotor in delocalized hover conditions using high-quality input data, and the results are successfully correlated to experiment results. The method proves to be robust and computationally very time saving.
Author (AIAA)
Noise Prediction; Supersonic Speed; Subsonic Speed; Numerical Integration; Computational Fluid Dynamics; Rotary Wings; Propeller Noise; Turbine Wheels; Computational Grids

19980051655

Modelling of turbulent mixing noise - Application to subsonic and supersonic jet noise

Bailly, Christophe, Lyon, Ecole Centrale, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This study describes statistical models of turbulent mixing noise in which the turbulent flow field is known only by statistical quantities such as the turbulent kinetic energy and its dissipation rate. A brief review of Lighthill's aerodynamic noise theory is presented. Ribner's model describing isotropic turbulent sources is discussed, with emphasis placed on applications to jet noise. The case of a perfectly expanded jet at M = 2 is illustrated. Some improvements are also summarized.
AIAA
Turbulent Jets; Jet Aircraft Noise; Subsonic Flow; Supersonic Jet Flow; K-Epsilon Turbulence Model

19980051656

Some useful turbulence tools for aeroacoustics

Comte-Bellot, Genevieve, Lyon, Ecole Centrale, France; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A quantitative description of a turbulent field, and its numerical prediction, are presented. Governing equations, the turbulent kinetic energy budget, and dissipation are examined, with emphasis on total instantaneous Navier-Stokes equations, equations for the mean velocity, equations for the velocity fluctuations, and the kinetic energy budget. General expressions for 1D and 3D spectra are given. Length and time scales, the k-epsilon model, direct numerical simulation, and the large eddy simulation are considered.
AIAA
Aeroacoustics; Aerodynamic Noise; Unsteady Flow; Turbulent Flow; Isotropic Turbulence; K-Epsilon Turbulence Model

19980051864

Measurement of physical signals in the rotating part of an electrical machine by means of optical fibre transmission

Yahoui, Hamed, UPRES CNRS, France; Grellet, Guy; Measurement: Journal of the International Measurement Confederation; Mar, 1997; ISSN 0263-2241; Volume 20, no. 3, pp. 143-148; In English; Copyright; Avail: Issuing Activity

Monitoring systems of the rotating parts of machines are difficult to elaborate. The problem lies in the transmission of this information from the rotating rotor to the fixed stator, given the inherent presence of the electromagnetic field. In this paper we propose a new transmission system with optical fiber for all types of signals, which is also not subject to electromagnetic interference. An application to thermal monitoring has been tested to detect a rotor fault of the cage of an asynchronous motor. A multi-winding model is used to show the new bar current distribution in the cage in case of a broken bar.
Author (EI)
Light Transmission; Signal Measurement; Optical Communication; Optical Fibers; Induction Motors; Stators; Rotors; Winding

19980055407

Installed jet noise prediction model for coaxial jets

Bhat, T. R. S., Boeing Commercial Airplane Group, USA; Blackner, A. M., Boeing Commercial Airplane Group, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20267
Report No.(s): AIAA Paper 98-0079; Copyright; Avail: Aeroplus Dispatch

A semi-empirical model for the prediction of installed jet noise of coaxial jets in the presence of ambient flow has been developed. The model has been developed using the data obtained from the installed high bypass ratio jet model test in a free-jet wind tunnel. Acoustic data were obtained at various azimuthal (circumferential) and polar angles. Mapping of the noise source regions was made by using a phased array system of microphones. The model simulates the effects on jet noise due to jet angle-of-attack,

engine pitch angle with respect to the wing, engine location with respect to the wing, flap settings, and azimuthal variation. Comparisons of prediction with static and wind tunnel model data show good agreement.
Author (AIAA)
Noise Prediction; Coaxial Flow; Jet Flow; Noise Measurement; Wind Tunnel Tests; Jet Aircraft Noise

19980055408

Installation effects on coaxial jet noise - An experimental study

Blackner, A. M., Boeing Commercial Airplane Group, USA; Bhat, T. R. S., Boeing Commercial Airplane Group, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20267
Report No.(s): AIAA Paper 98-0080; Copyright; Avail: Aeroplus Dispatch

This experimental study of installation effects on coaxial jets included more realistic commercial transport aircraft and engine details and their associated flow fields in an anechoic wind tunnel. An aircraft wing with an 'installed' jet simulator can have a significant impact on the jet noise source and radiation. Previously, most jet noise studies have been limited to 'isolated' jets and noise suppressors. A recent installed jet noise test conducted by Shivashankara and Blacknet (1997) describes installation effects by comparing isolated and installed configurations, as well as numerous flap deflection settings and inboard and outboard installation locations. These test results continue that work by comparing realistic engine configuration details, like bifurcation design, configuration angle of attack, engine location relative to the wing leading edge, and engine pitch angle with respect to wing incidence angle. to help explain installation effects, acoustic data and velocity profiles comparisons are analyzed. Results of this experimental program conducted on co-axial jet nozzle configurations are presented in this paper.
Author (AIAA)
Jet Aircraft Noise; Coaxial Flow; Transport Aircraft; Anechoic Chambers; Wind Tunnel Tests

19980055410

Evaluation of turbulence-model performance as applied to jet-noise prediction

Woodruff, S. L., Florida State Univ., Tallahassee, USA; Seiner, J. M., NASA Langley Research Center, USA; Hussaini, M. Y., Florida State Univ., Tallahassee; Erlebacher, G., Florida State Univ., Tallahassee; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0083; Copyright; Avail: Aeroplus Dispatch

The accurate prediction of jet noise is possible only if the jet flow field can be predicted accurately. Predictions for the mean velocity and turbulence quantities in the jet flow field are typically the product of a Reynolds-averaged Navier-Stokes solver coupled with a turbulence model. To evaluate the effectiveness of solvers and turbulence models in predicting those quantities most important to jet noise prediction, two CFD codes and several turbulence models were applied to a jet configuration over a range of jet temperatures for which experimental data are available.
Author (AIAA)
Turbulence Models; Noise Prediction; Jet Aircraft Noise; Computational Fluid Dynamics

19980055485

Numerical simulation of gust generated aeroacoustics in a cascade using the space-time conservation element and solution element method

Wang, Xiao-Yen, NASA Lewis Research Center, USA; Chow, Chuen-Yen, Colorado, Univ., Boulder; Chang, Sin-Chung, NASA Lewis Research Center, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG3-1566
Report No.(s): AIAA Paper 98-0178; Copyright; Avail: Aeroplus Dispatch

The aeroacoustic field generated by the interaction of a vortical gust with flat-plate airfoils in a cascade is numerically studied by using the space-time Conservation Element and Solution Element (GE/SE) method. This problem is one of the benchmark problems in Category 3 (Turbomachinery Noise) of the Second Computational Aeroacoustics (CAA) Workshop sponsored by NASA/Langley and Florida State University. Converged time periodic solutions are obtained by using a CE/SE time-marching scheme for the full Euler equations with a simple nonreflecting boundary condition that is not based on the characteristic theory. Comparisons between the CE/SE solution and the analytical solution show excellent agreement.
Author (AIAA)
Cascade Flow; Gust Loads; Conservation Equations; Airfoils; Turbomachinery; Noise Prediction

19980055563

Advances in understanding supersonic jet screech

Raman, Ganesh, NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0279; Copyright; Avail: Aeroplus Dispatch

Screech tones are produced by imperfectly expanded jets under certain conditions. This paper provides an overview of developments in the field of supersonic jet screech. The overview includes a historical background, summary of recent developments, and a critical assessment of our current understanding of screech.

Author (AIAA)

Supersonic Jet Flow; Screech Tones; Shock Wave Interaction; Jet Impingement; Jet Aircraft Noise

19980055564

Noise measurements in supersonic jets treated with the Mach wave elimination method

Papamoschou, Dimitri, California, Univ., Irvine, USA; Debiasi, Marco, California, Univ., Irvine; Jan. 1998; In English

Contract(s)/Grant(s): NAG3-1981

Report No.(s): AIAA Paper 98-0280; Copyright; Avail: Aeroplus Dispatch

We report noise measurements for perfectly-expanded coaxial jets composed of a supersonic primary stream at velocity of 920 m/s and a coflow stream at conditions designed to prevent formation of Mach waves. The resulting sound field was compared to that emitted by a single jet at the conditions of the primary stream. Overall sound pressure levels (OASPL) and noise spectra were obtained at many radial and azimuthal positions around the jet exit. Equal-thrust comparisons were made by using geometric scaling. At equal thrust, Mach wave elimination reduced the nearfield OASPL by 11 dB and the far-field OASPL by 5 dB. The mid-to-high frequency region of the spectrum, which is most pertinent to aircraft noise, was reduced by 20 dB in the near field and by 9 dB in the far field. It is demonstrated that Mach waves account for at least 85 percent of the sound field most relevant to aircraft noise.

Author (AIAA)

Jet Aircraft Noise; Supersonic Jet Flow; Noise Measurement; Sound Fields; Noise Spectra

19980055565

Density measurement in underexpanded supersonic jets using Rayleigh scattering

Panda, J., Modern Technologies Corp., USA; Seasholtz, R. G., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0281; Copyright; Avail: Aeroplus Dispatch

The density field of underexpanded supersonic free jets issuing from a choked circular nozzle was measured using a Rayleigh scattering-based technique. This reliable and nonintrusive technique is particularly suitable for the high speed flows and is fundamentally superior to the intrusive probes and particle-based techniques such as LDV. A CW laser and photon-counting electronics were employed for the time- and phase-averaged density measurement with small uncertainty level (within 1 percent). The use of dust-free air for the entrained flow allowed measurement in the shear layer region. The free jets were produced in the plenum to ambient pressure ratio range of 1.88 to 5.75, which corresponded to a fully expanded Mach number range of 0.99 to 1.8. A comparative study of schlieren photographs and the time-averaged density data provided insight into the shock-cell structures. The supersonic free jets produced screech sound. A phase-averaged photon counting technique, using the screech tone as the trigger source, measured the unsteady density variation. The phase-averaged density data show the evolution of the large-scale turbulent vortices, phase-locked with the screech tone and responsible for its production.

Author (AIAA)

Supersonic Jet Flow; Rayleigh Scattering; Density Measurement; Pressure Oscillations; Screech Tones; Jet Aircraft Noise

19980055566

Numerical simulations of shock-vortex interactions in supersonic jet screech

Manning, Ted A., Stanford Univ., USA; Lele, Sanjiva K., Stanford Univ., USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0282; Copyright; Avail: Aeroplus Dispatch

Supersonic jet screech is a form of jet noise which adversely impacts both the environment and the life of aircraft structures. A basic understanding of the mechanisms which generate the screech tone and determine its amplitude is therefore important. We perform direct numerical simulations of the interaction of an oblique shock with instability waves of a finite thickness supersonic shear layer; we thereby retain the basic elements of an isolated jet screech source. The simulations are carried out in 2D using a high-order accurate spatial scheme with nonreflecting boundary conditions. The unsteady shock motion is resolved with the essentially nonoscillatory discontinuity capturing scheme. The shear layer is forced at the most unstable frequency, so that the instability waves develop into fully formed vortices upstream of the shock. The interaction of the vortices with the shock causes streamwise

oscillations in the shock near its tip. On the subsonic side of the shear layer, the acoustic wave is released as the shock tip deflects upstream through the braid region between vortices. This acoustic field is nearly cylindrical, with nearly uniform directivity. On the supersonic side of the shear layer, a complex wave field is observed.
Author (AIAA)
Supersonic Jet Flow; Shock Wave Interaction; Vortices; Screech Tones; Jet Aircraft Noise; Shear Layers

19980055567

Numerical simulation of the generation of axisymmetric mode jet screech tones

Shen, Hao, Florida State Univ., Tallahassee, USA; Tam, Christopher K. W., Florida State Univ., Tallahassee; Jan. 1998; In English
Contract(s)/Grant(s): F33615-96-D-3011
Report No.(s): AIAA Paper 98-0283; Copyright; Avail: Aeroplus Dispatch

An imperfectly expanded supersonic jet invariably radiates both broadband noise and discrete-frequency sound called screech tones. Screech tones are known to be generated by a feedback loop driven by the large scale instability waves of the jet flow. Inside the jet plume is a quasi-periodic shock cell structure. The interaction of the instability waves and the shock cell structure, as the former propagates through the latter, is responsible for the generation of the tones. Presently, there is no known way to predict the screech tone intensity. In this work, the screech phenomenon of an axisymmetric jet at low supersonic Mach number is reproduced by numerical simulation. The computed mean velocity profiles and the shock cell pressure distribution of the jet are found to be in good agreement with experimental measurements, as is the simulated screech frequency. Calculated screech tone intensity and directivity at selected jet Mach number are reported; these results demonstrate that numerical simulation using computational aeroacoustics methods offers not only a reliable way to determine the screech tone intensity and directivity, but also an opportunity to study the physics of the phenomenon by an entirely new approach.
Author (AIAA)
Supersonic Jet Flow; Screech Tones; Jet Aircraft Noise; Shock Wave Interaction

19980055642

Low dispersion finite volume schemes in the resolution of vortex shedding noise

Nance, Douglas V., USAF, Research Lab., Eglin, USA; Sankar, L. N., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0366; Copyright; Avail: Aeroplus Dispatch

The recently developed low dispersion finite volume schemes are applied in a numerical simulation of the aeroacoustic noise created by the shedding of vortices from a circular cylinder. This analysis, based on first principles, involves the numerical solution of the laminar, compressible Navier-Stokes equations in 2D. Around the cylinder, the flow and acoustic fields are coupled naturally through the governing equations. No secondary simulations or integral methods necessitating a foreknowledge of the flow field are required to generate the acoustic field. Aerodynamic and/or spectral results are presented to validate the flow/acoustic solver at Reynolds numbers 40 and 200. The agreement between the numerical solutions and the archival data is excellent. For aeroacoustic analysis, directivity profiles have been calculated for mean-squared perturbation pressure throughout the flow field. These profiles are presented, analyzed based on the physical characteristics of the noise source, and then compared to classical results. Power spectral densities are presented for locations directly above the cylinder and in the cylinder wake. The numerical solution clearly portrays the correct physics for vortex shedding noise at Reynolds number 200.
Author (AIAA)
Vortex Shedding; Finite Volume Method; Aeroacoustics; Aerodynamic Noise; Circular Cylinders; Flow Distribution

19980055725

Wind tunnel measurements of the airframe noise of a high-speed civil transport

Herkes, William H., Boeing Commercial Airplane Group, USA; Stoker, Robert W., Boeing Commercial Airplane Group, USA; Jan. 1998; In English
Contract(s)/Grant(s): NAS1-20220
Report No.(s): AIAA Paper 98-0472; Copyright; Avail: Aeroplus Dispatch

A model-scale airframe noise test of a high-speed civil transport (HSCT) was conducted in the Boeing Low-speed Aeroacoustic Facility. The test had the following objectives: provide an estimate of HSCT airframe noise levels; identify the major HSCT airframe noise sources; and assess the accuracy of the current HSCT airframe noise predictions. The noise levels were estimated by projecting data from free-field microphones to full-scale conditions. The result was an approach level of 91 EPNdB, well below current requirements. The sources of airframe noise were identified by using a phased microphone array. The identified sources

included the landing gear, the wingtips, the nacelles, and the tail. The NASA ANOPP prediction procedure was shown to be adequate for current needs, and empirical adjustments were suggested that could improve it for HSCT applications.
Author (AIAA)
Wind Tunnel Tests; Airframes; Noise Measurement; Aircraft Noise; Aeroacoustics

19980055729

A mechanism for ice roughness formation on an airfoil leading edge, contributing to glaze ice accretion

Tsao, J. C., Iowa State Univ., Ames, USA; Rothmayer, A. P., Iowa State Univ., Ames; Jan. 1998; In English
Contract(s)/Grant(s): F49620-95-1-0275
Report No.(s): AIAA Paper 98-0485; Copyright; Avail: Aeroplus Dispatch

A new viscous-inviscid interaction triple-deck structure is developed to describe the thermo-mechanical interaction of an air boundary layer with ice sheets and liquid films. Linear stability results are compared with nonlinear triple-deck computations, and a number of nonlinear simulations of liquid film and ice-water-air interactions are presented. A novel broadband surface icing instability is encountered in regimes with simultaneous wall and air cooling. This instability is believed to admit small-scale and highly irregular surface roughness. It is also found in all cases computed in this study that the ice roughness quickly ruptures the liquid film, leading to the early creation of water beads.
Author (AIAA)
Aircraft Icing; Leading Edges; Airfoils; Surface Roughness; High Reynolds Number; Air Water Interactions

19980055857

The generation of boundary layer instability noise on aerofoils

Lowson, Martin V., Bristol, Univ., UK; McAlpine, Alan, Bristol, Univ., UK; Nash, Emma C., Bristol, Univ., UK; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0627; Copyright; Avail: Aeroplus Dispatch

An experimental and theoretical investigation has been carried out to further understand the tonal noise generation mechanism on aerofoils. Experiments were conducted on NACA 0012 aerofoil sections in a low-turbulence closed working section wind tunnel which was modified to approximate to anechoic conditions. Narrow band acoustic tones were observed up to 30 dBs above background noise. High resolution flow velocity measurements have been made with a three component laser Doppler anemometer (LDA) which have revealed the presence of strongly amplified boundary layer instabilities in a region of separated shear flow just upstream of the pressure surface trailing edge. These instabilities match the frequency of the acoustic tone for each case and corresponding flow visualization experiments have shown these instabilities to roll up to form a regular Karman type vortex street. As a basis for a prediction model of the discrete tones the growth of fixed frequency, spatially growing boundary layer instability waves propagating over the aerofoil pressure surface have been calculated to model the basic flow using experimentally obtained boundary layer characteristics. The effect of boundary layer separation has been incorporated into the model. Prediction of T-S eigenmodes are in remarkably good agreement with experimental data. A new mechanism for tonal noise generation has been proposed which is based on the interaction of an unsteady outer flow with the T-S instability waves
Author (AIAA)
Airfoil Profiles; Boundary Layer Stability; Noise Generators; Aerodynamic Noise

19980055858

Numerical simulation of fluctuations leading to noise in a flap-edge flowfield

Streett, C. L., NASA Langley Research Center, USA; Jan. 1998; In English
Report No.(s): AIAA Paper 98-0628; Copyright; Avail: Aeroplus Dispatch

We develop an approximate computational framework for simulation of the fluctuating flowfield associated with the complex vortex system seen at the side edge of a flap in a multi-element high-lift airfoil system. The eventual goal of these simulations is to provide an estimate of the spectral content of these fluctuations, in order that the spectrum of the noise generated by such flowfields may be estimated. Results from simulations utilizing this computational framework are shown.
Author (AIAA)
Digital Simulation; Flaps (Control Surfaces); Airfoil Profiles; Aircraft Noise; Air Flow; Lift

19980055913

Detailed measurements of a flap side-edge flow field

Radeztsky, Ronald H., Jr., High Technology Corp., USA; Singer, Bart A., High Technology Corp., USA; Khorrami, Mehdi R., High Technology Corp., USA; Jan. 1998; In English

Contract(s)/Grant(s): NAS1-20059; NAS1-20103
Report No.(s): AIAA Paper 98-0700; Copyright; Avail: Aeroplus Dispatch

Detailed flow measurements were performed with a five-hole probe in the flap side-edge region of a wing with a half-span flap. The experiments were conducted in the NASA-Langley Quiet Flow Facility as a part of an extensive experimental and computational investigation of airframe-related noise sources. Basic flow properties were verified using static pressure taps, pressure-sensitive paint, and oil-flow visualization. Detailed five-hole probe surveys were conducted in a set of planes at 10 streamwise stations for flap deflections of 29 and 39 deg. The measurements show the development of a two-vortex system at the flap side edge. The vortex path and strength are determined, and the process of vortex merging is documented in detail in the midchord region. At the higher flap deflection angle, vortex bursting is observed, which may be a factor in the observed higher noise levels for this condition. Results are compared with Reynolds-averaged Navier-Stokes calculations of a similar configuration. These measurements and calculations form the basis for instability modeling and unsteady calculations which will ultimately lead to an understanding of flap side-edge noise sources.

Author (AIAA)

Flow Measurement; Wing Flaps

19980056053

Development of a three dimensional radiative heat transfer computational methodology for aircraft engine combustors

Kumar, Ganesh N., ACRi, Inc., USA; Moder, Jeffrey P., NASA Lewis Research Center, USA; Mongia, Hukam, GE Aircraft Engines, USA; Prakash, Chander, GE Aircraft Engines, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0855; Copyright; Avail: Aeroplus Dispatch

A computational methodology for radiative heat transfer analysis in 3D nongray enclosures is presented. This methodology, which is applicable to aircraft engine combustors, includes the nongray interaction of the multiple gaseous species, H2O, CO2, and CO, respectively. It also includes models for luminous radiation from soot. The analysis procedure uses a finite volume methodology (FVM) in body-fitted coordinates for radiative transfer along with the weighted-sum-of-gray gases concept for treating the nongray gases. The methodology provides the divergence of radiative heat flux at each cell of the FVM grid for inclusion in the flow solver. It also provides the radiative heat flux and intensity of radiation at each cell. The methodology has been validated by application to a wide variety of test cases. Application to a generic combustor is also made.

Author (AIAA)

Three Dimensional Flow; Radiative Heat Transfer; Aircraft Engines; Combustion Chambers; Finite Volume Method

19980056136

Modeling the response from a cascade to an upstream acoustic disturbance

Paynter, Gerald C., Boeing Co., USA; Clark, Larry T., Boeing Co., USA; Cole, Gary L., NASA Lewis Research Center, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0953; Copyright; Avail: Aeroplus Dispatch

Time-accurate Euler flow field simulations for the flow through a two-dimensional cascade subjected to an upstream acoustic disturbance were used as the basis for a small disturbance model to predict the reflected response upstream of the cascade. The small disturbance model results in a linear system of algebraic equations for the properties of the reflected and transmitted disturbances. The model predicts the reflected and transmitted responses as a function of the cascade blade geometry, the disturbance strength, and the initial flow properties prior to the upstream disturbance. The predicted results from the small disturbance model were then compared with the Euler analysis results for a two-dimensional cascade. Agreement between the model and the Euler data indicated that the model was potentially useful as a basis for an outflow boundary condition for time-accurate Euler/Navier-Stokes (ENS) simulations of supersonic mixed compression inlet flows needed to determine the stability margin of an inlet that encounters an atmospheric disturbance. This boundary condition must provide an approximation of the response from the compressor by the inlet flow at the face of the compressor when a disturbance from upstream passes through the inlet and into the compressor. A new characteristic boundary condition based on the small disturbance response model was formulated and demonstrated independently in two one-dimensional Euler codes. The one-dimensional Euler codes with the new boundary condition and with existing boundary condition formulations were used to predict the reflection response for an axial compressor experiment. The new boundary condition was found to provide a significant improvement in accuracy for the reflection response of an acoustic disturbance from a compressor relative to existing outflow boundary condition models. For a supersonic mixed compression inlet, a one-dimensional Euler code was also used to demonstrate the dependence of the inlet normal-shock response and unstart tolerance on the outflow boundary condition.

Author (AIAA)

Cascade Flow; Two Dimensional Flow; Aeroacoustics; Atmospheric Turbulence; Supersonic Aircraft

19980056441

AHS Technical Specialists' Meeting for Rotorcraft Acoustics and Aerodynamics, Williamsburg, VA, Oct. 28-30, 1997, Proceedings

1997; In English; Copyright; Avail: Aeroplus Dispatch

The present volume on rotorcraft acoustics and aerodynamics discusses external noise, computational methods, flight acoustics and evaluation, active controls, aerodynamics and vibration, and aerodynamics and wakes. Attention is given to broadband helicopter rotor noise, methods for the prediction of blade-vortex interaction noise, recent rotor CFD development for capturing vortex, and a parallel numerical rotor tip design procedure for shock attenuation. Other topics addressed include time-frequency analysis of helicopter noise, a rotorcraft noise model, the effects of tip shapes on rotor noise, and a computational analysis of acoustic focusing effects during parallel and oblique blade-vortex interactions.

AIAA

Conferences; Aeroacoustics; Aerodynamic Characteristics; Aircraft Noise; Blade-Vortex Interaction

19980056442

Blade wake interaction noise for a BO-105 model main rotor

Burley, C. L., NASA Langley Research Center, USA; Brooks, T. F., NASA Langley Research Center, USA; Splettstoesler, W. R., DLR, Germany; Schultz, K.-J., DLR, Germany; Kube, R., DLR, Germany; Bucholtz, H., DLR, Germany; Wagner, W., DLR, Germany; Weitemeyer, W., DLR, Germany; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Fundamental characteristics of blade wake interaction (BWI) noise are determined, and a prediction method is developed, using acoustic and blade pressure data from a four-bladed BO-105 model helicopter main rotor. BWI is a broadband noise source caused by the blade interactions with turbulence in the rotor wake, particularly about tip vortices. The data are from the rotor aeroacoustic test program called HART, which was jointly conducted by European and American government agencies in the German-Dutch Wind Tunnel, DNW. The test data include simultaneous measurements of instantaneous blade pressures and acoustic time histories as well as averaged data. The statistical character of the BWI is determined from the instantaneous surface pressures. A BWI noise metric is developed, and BWI noise directivity contours (similar to those typically presented for BVI noise) are presented and shown to be a function of rotor tip-path-plane angle. Similarly, BWI blade pressure contours over the rotor disk are presented.

Author (AIAA)

BO-105 Helicopter; Rotor Blades; Helicopter Wakes; Aircraft Models; Noise Prediction (Aircraft); Blade-Vortex Interaction

19980056443

Broadband helicopter noise generated by blade wake interactions

Glegg, Stewart A. L., Florida Atlantic Univ., Boca Raton, USA; Wittmer, Kenneth S., Virginia Polytechnic Inst. and State Univ., Blacksburg; Devenport, William J., Virginia Polytechnic Inst. and State Univ., Blacksburg; Pope, D. S., Computer Sciences Corp., USA; 1997; In English

Contract(s)/Grant(s): NAG1-1539; Copyright; Avail: Aeroplus Dispatch

Broadband noise from helicopter rotors is shown to be generated by the blades passing through turbulence associated with the walling tip vortices in the rotor wake. This happens when the trailing tip vortices are ingested into the rotor and during flight regimes such as level flight or low angles of ascent. to predict the broadband noise levels generated by this mechanism, the details of the turbulent flow close to trailing tip vortices must be known accurately, and the location of the vortices relative to the rotor blades must be specified. This study evaluates recent wind tunnel measurements of turbulent trailing tip vortices and specifies a model for the turbulent velocity spectrum and the size of the turbulent region. The results are then combined with the calculations of the trailing vortex locations obtained from the CAMRAD code to give absolute noise level predictions. The predictions are compared with measurements and show that the flow modeling accurately predicts the spectral shape but tends to underpredict the overall level. However, the overall level is very sensitive to the wake calculations obtained from the CAMRAD code, and blade vortex miss distance is found to be the most important source of error in the noise calculations.

Author (AIAA)

Helicopter Wakes; Blade Tips; Blade-Vortex Interaction; Noise Prediction (Aircraft); Wind Tunnel Tests; Turbulent Flow

19980056444

Helicopter rotor noise prediction using ONERA and DLR Euler/Kirchhoff methods

Zibi, J., ONERA, France; Polacsek, C., ONERA, France; Kuntz, M., DLR, Germany; Rouzaud, O., ONERA, France; 1997; In English

Report No.(s): ONERA, TP no. 1997-192; Copyright; Avail: Aeroplus Dispatch

Euler/Kirchhoff methods have been developed at ONERA and DLR to predict the high speed impulsive (HSI) noise generated by helicopter rotors in hover or in forward flight. This work validates the aeroacoustic computations with delocalized test cases. In hover, the aerodynamic and acoustic results obtained by each partner are in good agreement with experiment. In forward flight, a first set of computations is performed with three different sized 'classical' grids. For both partners, the pressure coefficients on the blade are in better correlation with experiment when the grid is refined. However, the capture of the shock waves' propagation beyond the blade is not accurate enough to perform satisfactory Kirchhoff computations. The minimum pressure peak and the recompression slope of the acoustic pressure signatures are not accurately predicted, whatever the grid refinement or the Kirchhoff surface locations may be. An 'adapted' grid has been generated in order to improve the aeroacoustic computations in the far field. The results show the importance of the grid adaptation to perform stable and accurate HSI noise predictions.
Author (AIAA)
Rotary Wings; Noise Prediction (Aircraft); Kirchhoff Law; Rotor Blades

19980056446

Investigation of broadband helicopter rotor noise

Brezillon, J., ONERA, France; Prieur, J., ONERA, France; Rahier, G., ONERA, France; 1997; In English
Report No.(s): ONERA, TP no. 1997-194; Copyright; Avail: Aeroplus Dispatch

An investigation on blade-wake interaction (BWI) is performed in realistic helicopter rotor noise cases. The study is based on acoustic and blade pressure measurements from the HART test and on rotor wake numerical simulations. The main features of BWI noise including its directivity are deduced from a processing of acoustic measurements. Correlation between experimental aerodynamic results and wake calculations confirm that perpendicular interactions of the blade with tip vortex turbulence are a major contribution to BWI in low-speed level flight and climb. It is also shown that very close parallel interactions which generate blade-vortex interactions (BVI) noise in descent flight, can also generate BWI noise. The necessity of an accurate knowledge of the turbulence distribution inside the interacting vortex and the neighboring wake is pointed out.
Author (AIAA)
Helicopter Wakes; Aircraft Noise; Rotor Blades; Blade-Vortex Interaction; Blade Tips; Turbulent Flow

19980056467

Acoustic flight testing of a Boeing MD explorer and a Sikorsky S-76B using a large area microphone array

Jacobs, Eric W., Sikorsky Aircraft, USA; O'Connell, James M., Boeing Co., USA; Conner, David A., U.S. Army, Joint Research Program Office, USA; Rutledge, Charles K., Lockheed Martin Engineering & Sciences, USA; Wilson, Mark R., Lockheed Martin Engineering & Sciences, USA; Shigemoto, Fred, NASA Ames Research Center, USA; Chen, Robert T. N., NASA Ames Research Center, USA; Fleming, Gregory G., DOT, Volpe National Transportation Systems Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

As part of a National Rotorcraft Technology Center (NRTC) and Rotorcraft Industry Technology Association (RITA) project to develop and flight test demonstrate noise abatement approach procedures, develop data acquisition procedures for land use planning data, and provide a data base for noise model development/validation, a flight test program was conducted at the NASA Ames Crows Landing Test Facility during October and November of 1996. The current paper summarizes the design and performance of the Noise Abatement Flight Procedures Test, including design of the microphone array, implementation of the aircraft tracking and guidance systems, and the development and use of enhanced on-site acoustic data processing capabilities to provide SEL noise contour plots (footprints) within one day of data acquisition.
Author (AIAA)
Boeing Aircraft; Flight Tests; Aeroacoustics; Microphones; Aircraft Noise

19980056469

Time-frequency analysis of helicopter noise

Celi, Roberto, Maryland, Univ., College Park, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

This paper summarizes the main properties of six time-frequency representations and describes their application to the analysis of typical helicopter rotor noise traces. Time-frequency representations may be a useful tool for the visual analysis of helicopter rotor noise, because they provide information not available from time or frequency-domain representations alone, such as the time variations of the spectrum of the signal or of its power spectrum, which translate into distinctive patterns on a time-frequency plot. No single representation is best for all cases. The Short-Time Fourier Transform and the spectrogram seem to have the most general usefulness. The Wigher-Ville distribution is useful when the noise events are well separated in time. The Choi-Williams distribution does not offer a significant practical improvement over the Wigher-Ville distribution. The Continuous Wavelet Transform and the scalogram do not appear to offer major advantages over Short-Time Fourier Transform and spectrogram. Time-

frequency representations require some tuning to achieve the most informative results; the specific parameters depend on the representation. This tuning is typically simple, and is not a major practical obstacle.
Author (AIAA)
Rotary Wings; Aircraft Noise; Power Spectra; Fourier Transformation

19980056475

A study of the effects of blade shape on rotor noise

Jones, Henry E., U.S. Army, Joint Research Program Office, USA; Burley, Casey L., NASA Langley Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

A new rotor noise prediction system called the Tiltrotor Aeroacoustic Code (TRAC) has been developed under the Short Haul (Civil Tiltrotor) program between NASA, the Army, and the U.S. helicopter industry. This system couples the comprehensive rotorcraft code CAMRAD.Mod1 with either the high resolution sectional loads code HIRES or the full potential CFD code FPRBVI to predict unsteady blade loads, which are then input to the noise prediction program WOPWOP. In this paper, HIRES is used to predict the blade-vortex interaction (BVI) noise trends associated with blade shape. The baseline shape selected was a 17 percent scale model of a contemporary design four-bladed rotor. Measurements for this rotor were acquired in the Duits-Nederslandse Windtunnel (DNW). The code is used to predict noise for the base configuration, and the results are compared to the measured data. This provides a firm foundation for investigating the BVI noise trends associated with blade shape. The shapes selected for study are based on variation of sweep and taper which reflect plausible 'passive' design concepts. Comparisons of power required, integrated noise, and aerodynamics are made, and important trends are noted.
Author (AIAA)
Tilt Rotor Aircraft; Rotor Blades; Surface Geometry; Noise Prediction (Aircraft); Short Haul Aircraft; Blade-Vortex Interaction

19980056477

Supersonic quadrupole noise theory for high-speed helicopter rotors

Farassat, F., NASA Langley Research Center, USA; Brentner, Kenneth S., NASA Langley Research Center, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

High-speed helicopter rotor impulsive noise prediction is an important current problem of aeroacoustics. In this paper, we give a simple formulation based on the acoustic analogy that is valid for both subsonic and supersonic quadrupole noise prediction. The model is exact for an observer in the far field and in the rotor plane and is approximate elsewhere. We give the full analytic derivation of this formulation. We present the method of implementation on a computer for supersonic quadrupoles using marching cubes for constructing the influence surface (Sigma surface) of an observer space-time variable (x, t). We then present several examples of noise prediction for both subsonic and supersonic quadrupoles. It is shown that in the case of transonic flow over rotor blades, the inclusion of the supersonic quadrupoles improves the prediction of the acoustic pressure signature. We show the equivalence of the new formulation to that of Brentner for subsonic quadrupoles. It is shown that the regions of high quadrupole source strength are primarily produced by the shock surface and the flow over the leading edge of the rotor.
Author (AIAA)
Rotary Wings; Supersonic Aircraft; Noise Prediction (Aircraft); Aeroacoustics; Sound Pressure; Rotor Blades

19980056479

Computation of high-speed impulsive noise by an enhanced Kirchhoff method

Algermissen, G., Stuttgart, Univ., Germany; Wagner, S., Stuttgart, Univ., Germany; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The objective of the present project is to develop an efficient tool for the prediction of noise generated by helicopter rotors in high-speed forward flight. This tool should be easy to handle, accurate and fast. A coupled Euler/Kirchhoff method in nonrotating formulation, which is adapted to the problem of high-speed impulsive noise, is described. The overall scheme allows the calculation of the acoustic signatures at several observer positions for rotors in forward flight with arbitrary blade motion. It is applied to main rotors in nonlifting hover and in lifting forward flight. The results are compared with experimental data. Agreement of computational and experimental results is very good for the nonlifting hovering rotor and satisfactory for rotors in lifting forward flight. The numerical efficiency of the Kirchhoff integration can be improved by application of azimuthal variable grid spacing on the Kirchhoff surface and by adaptation of the grid line shape to the pressure pattern on the Kirchhoff surface.
Author (AIAA)
Rotary Wings; Noise Prediction (Aircraft); Kirchhoff Law; Rotor Dynamics

19980056480

An extended Kirchhoff method for rotorcraft impulsive noise

Lyrintzis, A. S., Purdue Univ., USA; Koutsavdis, E. K., Purdue Univ., USA; Pilon, A. R., Pennsylvania State Univ., University Park; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Kirchhoff's method has been employed for the extension of CFD results to the far field. Kirchhoff's method allows radiating sound to be evaluated based on quantities evaluated on an arbitrary control surface, if the linear homogeneous wave equation is assumed outside the control surface. Thus, the control surface is assumed to include all the nonlinear flow effects and noise sources. The control surface cannot be very far away from the blade because of the diffusion and dispersion errors of the CFD solution due to grid stretching. Thus some nonlinearities may prevail outside the Kirchhoff surface. An extended Kirchhoff method that includes nonlinear quadrupole effects outside the control surface is evaluated. Preliminary results show that if the Kirchhoff surface is carefully chosen, the quadrupole effects outside this surface are not important.

Author (AIAA)

Aircraft Noise; Control Surfaces; Kirchhoff Law; Rotor Blades

19980056481

Acoustic focusing effects generated by parallel and oblique blade vortex interactions

Leishman, J. G., Maryland, Univ., College Park, USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Results are presented from a study of focusing effects found from parallel and oblique blade vortex interactions (BVIs). Both an idealized problem with an isolated line vortex, as well as self-induced epicycloidal vortices, are considered. The analysis is performed using a trace Mach number/radiation cone method and an indicial unsteady aerodynamics model coupled to a solution to the FW-H equation. It is shown how the BVI process can produce regions of highly focused noise in the far field. This directivity is clearly correlated to BVI source points with supersonic trace Mach numbers.

Author (AIAA)

Supersonic Aircraft; Blade-Vortex Interaction; Unsteady Aerodynamics; Aeroacoustics

19980056482

A study of rotorcraft blade-tip shape HSI noise characteristics

Lyrintzis, A. S., Purdue Univ., USA; Jameson, J. R., Purdue Univ., USA; Koutsavdis, E. K., Purdue Univ., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

We investigate the noise characteristics of blade tip shapes using the Kirchhoff method. The full potential code FPRBVI was used for the CFD, and Kirchhoff's method was employed for the extension of CFD results to the far field. Three basic blade tip shapes were tested. All blades were normalized to have the same area, and acoustic signals were tabulated and compared. Only HSI noise was considered in this study. Preliminary results show that the taper ratio is an important parameter, whereas the sweep angle is not. The conclusions drawn from this comparison are expected to contribute to the identification of rules that guide the design of quieter blade tip shapes.

Author (AIAA)

Aircraft Noise; Blade Tips; Blade-Vortex Interaction; Kirchhoff Law; Aircraft Wakes

19980056490

A study of rotorcraft structure-borne noise isolation using empirical component coupling

Unruh, James F., Southwest Research Inst., USA; Fox, Douglas J., Southwest Research Inst., USA; 1997; In English; Copyright; Avail: Aeroplus Dispatch

Control of component excitation generated structure-borne noise transmission into a rotorcraft cabin, such as from rotor vibration imbalance, transmission excitations, or auxiliary-equipment-induced vibrations, can be studied empirically via impedance characterization of the system components and application of appropriate component coupling procedures. The present study was aimed at demonstrating the usefulness of such impedance modeling techniques as applied to a Bell 206B rotorcraft. Simulated rotor excitations were applied to the assembled rotorcraft system to provide baseline structure-borne noise transmission data. Thereafter, impedance tests of the system components were carried out to provide a data base from which system component coupling studies were carried out. Results presented demonstrate the level of expected accuracy in predicted structure-borne noise transmission from the component coupled model. Compliance was then analytically introduced at attachments between system components to evaluate the level of expected structure-borne noise isolation for a given level of joint compliance.

Author (AIAA)

Noise Prediction (Aircraft); Noise Reduction; Aircraft Compartments; Aircraft Structures

19980056498

Predictions of unsteady-loading noise for slowly descent flights with a time-marching free-wake and articulated rotor

Na, Seon U., Korea Advanced Inst. of Science and Technology, Republic of Korea; Chung, Choon M., Korea Advanced Inst. of Science and Technology, Republic of Korea; Chung, Ki H., Korea Advanced Inst. of Science and Technology, Republic of Korea; Lee, Duck J., Korea Advanced Inst. of Science and Technology, Republic of Korea; 1997; In English; Copyright; Avail: Aeroplus Dispatch

The aeroacoustics of an articulated 3-DOF blade with hinge off-sets is examined. The time-marching free-wake model is used to calculate the geometry of the wake and the unsteady loading of the helicopter rotor. The vortex wake of the rotor is modeled as the curved vortex line using a parabolic blending curve. The wake is generated at each time step, and convected freely with local induced velocity. The blade time-dependent position is calculated from blade equilibrium equations. These are coupled equations and contain nonlinear geometric terms as well as periodic terms. The nonlinear time-dependent periodic blade response is calculated using an iterative procedure. The noise due to unsteady blade motion and aerodynamics is calculated using Lowson's theory. This is done by modeling the blade as an array of point sources with each point characterized by the force and motion of the associated blade section. Results are presented for both hover flight and slow descent flight.

Author (AIAA)

Rotary Wings; Blade-Vortex Interaction; Noise Prediction (Aircraft); Aerodynamic Loads; Descent Trajectories; Time Marching

19980056843

Photonic technology for switched RF avionics networks

Hamilton, Michael C., Boeing Defense & Space Group, USA; Thaniyavarn, Suwat, Boeing Defense & Space Group, USA; Abbas, Gregory L., Boeing Defense & Space Group, USA; LaGasse, Micael J., Boeing Defense & Space Group, USA; Traynor, Timothy, Boeing Defense & Space Group, USA; Lin, Jack P., Uniphase Telecommunications Products, USA; 1997, pp. 69-79; In English; Copyright; Avail: Aeroplus Dispatch

The application of photonics technology in switched RF networks is discussed with emphasis on the benefits for avionics applications. System requirements and performance issues are addressed. A 16x16 photonic switch module prototype is described, and results for RF fiber-optic links passing through the module are presented. RF channel isolation measured was at least 75 dB. A demonstration is described in which a photonic network using the switch module passed signals from a dynamic electromagnetic environment simulator to two radar warning systems under test. Demonstration modes included simulation of both aperture sharing and processor sharing. Finally, a novel alternative switch module architecture is described that is strictly nonblocking and has inherently better channel isolation.

Author (AIAA)

Avionics; Microwave Circuits; Fiber Optics; Optical Switching; Integrated Optics

19980060054

Determination of local phase holdups in airlift reactors by means of time-domain-reflectometry

Kochbeck, Birgit, Technical Univ. of Braunschweig, Germany; Lindert, Mark; Hempel, Dietmar C.; Chemical Engineering & Technology; Nov, 1997; ISSN 0930-7516; Volume 20, no. 8, pp. 533-537; In English; Copyright; Avail: Issuing Activity

Airlift loop reactors are useful in many chemical and biotechnological processes where three phase reaction systems are required. One example is biological waste water treatment. In order to enhance biological reaction rates it is often useful to immobilize the bacteria on carrier particles. Knowledge of solid distribution and local gas holdup in those systems is important for calculation of mass and energy transfer or reaction kinetics. For this reason a method has been developed which enables to measure such local phase holdups. The measuring system consists of a time-domain-reflectometry (TDR)-instrument in combination with a pressure difference meter. The method has successfully been applied to determine local axial gas and solid distribution in internal airlift loop reactors, filled with a three phase system consisting of water, air, and polymer particles.

Author (EI)

Air Transportation; Optical Measurement; Chemical Reactors; Reflectometers; Mass Transfer; Reaction Kinetics; Pressure Gages

19980064097

Evaluation of engineering heat transfer prediction methods in high-enthalpy flow conditions

Simeonides, G., ESTEC, Netherlands; Walpot, L., ESTEC, Netherlands; Netterfield, M., ESTEC, Netherlands; Tumino, G., ESTEC, Netherlands; Journal of Spacecraft and Rockets; Feb. 1998; ISSN 0022-4650; Volume 35, no. 1, pp. 107-109; In English Report No.(s): AIAA Paper 96-1860; Copyright; Avail: Aeroplus Dispatch

A coupling of the reference enthalpy formulation with thermochemical nonequilibrium Euler solutions has yielded an approximate heat transfer prediction methodology applicable to generic configurations in high-enthalpy flow conditions. Comparisons with thermochemical nonequilibrium Navier-Stokes solutions and experimental data from high-enthalpy wind tunnels show that the proposed methodology furnishes reasonable engineering estimates for heat transfer distribution over pressure-dominated configurations, at a computational cost that is much lower than that of Navier-Stokes solutions.
AIAA
Aerodynamic Heat Transfer; Enthalpy; Boundary Layer Equations; Aerothermochemistry; Nonequilibrium Thermodynamics; Convective Heat Transfer

19980064880

Wind turbine noise - Analysis of results from a new measurement technique

Lowson, Martin V., Bristol, Univ., UK; Lowson, Jonathan V., Flow Solutions, Ltd., UK; Bullmore, Andrew J., Hoare Lea and Partners, UK; 1998, pp. 129-138; In English
Report No.(s): AIAA Paper 98-0037; Copyright; Avail: Aeroplus Dispatch

A new postprocessing technique for wind turbine noise measurement and analysis has provided systematic, accurate, and repeatable data on wind turbine noise. This paper reports detailed results using the new technique. For the V34 wind turbine studied, a clear separation of aerodynamic noise and mechanical noise, as well as excellent definition of both directionality and wind speed/frequency dependence of the noise, especially the aerodynamic sources, was found. Comparison with theory has shown very satisfactory agreement for overall levels. The new approach has demonstrated considerable potential for providing more accurate and reliable data for characterization of wind turbine noise.
Author (AIAA)
Wind Turbines; Aerodynamic Noise; Noise Measurement; Noise (Sound); Wind Direction; Wind Velocity Measurement

19980064881

Experimental and theoretical characterization of acoustic noise from a 7.6 m diameter teetered rotor wind turbine

Moroz, Emil, Texas, Univ., El Paso, USA; 1998, pp. 139-146; In English
Report No.(s): AIAA Paper 98-0038; Copyright; Avail: Aeroplus Dispatch

An experimental investigation into the acoustic noise from a small (7.6 m diameter) teetered rotor wind turbine, set at various yaw angles up to 90 deg of yaw, was conducted. The results revealed 1/3-octave spectra dominated by a broad peak in the higher frequency range, at all yaw angles and wind speeds investigated. This prompted a theoretical investigation to reveal the mechanisms producing the dominant feature in the experimentally obtained noise spectra and resulted in the development of a wind turbine aerodynamic noise prediction code, WTNOISE. The location near busy roads and the relatively rough terrain of the wind test site caused difficulties in obtaining useful noise spectral information below 500 Hz. However, sufficiently good data were obtained above 500 Hz to clearly show a dominant 'hump' in the spectrum, centered between 3000 and 4000 Hz. The WTNOISE code indicated that the broad peak in the spectrum was most likely caused by trailing edge bluntness noise. Field data confirmed this hypothesis and also showed the beneficial effect of sharpening the trailing edge.
Author (AIAA)
Wind Turbines; Rotor Blades; Acoustic Propagation; Wind Tunnel Tests; Noise Spectra; Aerodynamic Noise

19980064919

Prediction of supersonic jet noise

Balakumar, P., Old Dominion Univ., USA; Jan. 1998; In English
Contract(s)/Grant(s): NAG1-1677
Report No.(s): AIAA Paper 98-1057; Copyright; Avail: Aeroplus Dispatch

Noise radiated from a supersonic jet is computed using the Parabolized Stability Equations (PSE) method. The evolution of the instability waves inside the jet is computed using the PSE method, and the noise radiated to the far field from these waves is calculated by solving the wave equation using the Fourier transform method. We performed the computations for a cold supersonic jet of Mach number 2.1 which is excited by disturbances with Strouhal numbers St = 0.2 and 0.4 and the azimuthal wavenumber m = 1. Good agreement in the sound pressure level is observed between the computed and the measured (Troutt and McLaughlin, 1980) results.
Author (AIAA)
Noise Prediction (Aircraft); Supersonic Jet Flow; Jet Aircraft Noise

19980064923

Acoustic shaping in microgravity

Wanis, S., Georgia Inst. of Technology, Atlanta, USA; Akovenko, J., Georgia Inst. of Technology, Atlanta; Cofer, T., Georgia Inst. of Technology, Atlanta; Ames, R., Georgia Inst. of Technology, Atlanta; Komerath, N., Georgia Inst. of Technology, Atlanta; Jan. 1998; In English

Report No.(s): AIAA Paper 98-1065; Copyright; Avail: Aeroplus Dispatch

With gravity reduced, the resonant acoustic field and streaming flow in a container drive particles to stable positions along specified surfaces, whose shape can be tailored. This paper describes results from a flight experiment on the NASA KC135 Reduced Gravity Laboratory to explore the generation of complex shapes. Four speakers are used to excite predetermined resonant modes in a rectangular chamber, containing solid particles, during eighty parabolic flight segments. Particle behavior and the sound spectra, correlated with the acceleration level, are monitored. Randomly-shaped styrofoam particles and a granular cereal are used to represent particles of various characteristics. The particles are entrained by the streaming flow in the chamber and carried to stable surfaces, where they remain steady without rotation. Surface shapes vary as predicted by the contours of pressure amplitude and are offset from the nodes. The input sound power level required to form the surfaces is low. Higher sound levels modify the streaming flow and are less efficient in forming the surfaces.

Author (AIAA)

Microgravity; Sound Waves; C-135 Aircraft; Shapes

19980065196

Experimental validation of an acoustic model for high-power supersonic jets ***Validation experimentale d'un modele acoustique pour des jets supersoniques de forte puissance***

Varnier, J., ONERA, France; Gely, D., ONERA, France; ONERA, TP no. 1997-53; 1997; In French

Report No.(s): ONERA, TP no. 1997-53; Copyright; Avail: Aeroplus Dispatch

With the support of CNES, ONERA carried out several tests on static solid rockets. In order to extrapolate the results to the launchers at full scale, these size rockets had aerothermodynamic similitudes. The sound radiated by the jet is modeled using an empirical approach, based on NASA works. The good simulation of the cross-spectral densities, as well as the measured acoustic levels, assured us that the MINOTAURE computer code is able to accurately simulate the acoustic field. The acoustic efficiency appears constant, for a given Mach number of fully expanded jets.

Author (AIAA)

Proving; Supersonic Jet Flow; Solid Propellant Rocket Engines; Aerothermodynamics; Aerodynamic Noise

19980065420

Thermodynamic analyses of the performance of a thermal-storage system with water as its working fluid

Chen, G. M., Univ. of Tokyo, Japan; Lu, G. Q.; Wang, J. F.; Applied Energy; Aug, 1997; ISSN 0306-2619; Volume 57, no. 4, pp. 263-270; In English; Copyright; Avail: Issuing Activity

A thermal storage system for air-conditioning with water as its working substance is proposed and analyzed. Because water is a natural substance, the system has no environmental problems. The system consists of a steam compressor, a condenser, an expansion valve, a separator, two ejectors, an evaporator and a pump. Owing to the pump and ejectors, the compression ratio and the swept volume of the compressor are much smaller than those of a traditional system at lower evaporating temperatures. The new system can be used for ordinary air-conditioning or for thermal storage or both. A numerical simulation has been conducted to analyze the characteristics of the system under different working conditions. The results were compared with those of traditional systems using water or R22 as the working medium.

Author (EI)

Compression Ratio; Heat Storage; Working Fluids; Cooling Systems; Air Conditioning; Thermal Analysis; Water; Compressors

19980067864

Use of linearized Euler equations for supersonic jet noise prediction

Mankbadi, R. R., NASA Lewis Research Center, USA; Hixon, R., NASA Lewis Research Center, USA; Shih, S.-H., NASA Lewis Research Center, USA; Povinelli, L. A., NASA Lewis Research Center, USA; AIAA Journal; Feb. 1998; ISSN 0001-1452; Volume 36, no. 2, pp. 140-147; In English

Report No.(s): AIAA Paper 95-0505; Copyright; Avail: Aeroplus Dispatch

The use of linearized Euler equations for direct prediction of supersonic jet noise is explored. It is shown that a high-order numerical scheme coupled with proper boundary treatment can produce a stable solution nearly free from reflections. Results are verified against analytical results for sound radiated by instability waves. The applicability of this approach to real jets is explored

by taking the inflow disturbances to be random in time and comparing the computed sound field to the experimentally measured one.
Author (AIAA)
Aerodynamic Noise; Supersonic Jet Flow; Linear Equations; Euler Equations of Motion

19980069542

Aeroacoustics methods for fan noise prediction and control

Henshaw, David, Rolls-Royce PLC, UK; Nouvelle Revue d'Aeronautique et d'Astronautique; Sep. 1997; ISSN 1247-5793, no. 4, pp. 19-27; In English; Copyright; Avail: Aeroplus Dispatch

A collaborative European research program, 'Aeroacoustic Methods for Fan Noise Prediction and Control' (FANPAC), has been completed, which aimed at providing European airframe, engine, and nacelle manufacturers with the technology required to control fan tone noise on future civil transport aircraft equipped with advanced high-bypass-ratio (typically 6:1), very-high-bypass-ratio (typically 9:1), or ultrahigh-bypass-ratio (typically 12:1-15:1) turbofans. The 42-month program included research on the development of novel acoustic liners, the study of noise generation processes, and the testing of a model fan rig. The fan test included various drooped intake ducts, acoustic liners, and sophisticated instrumentation. The test provided data to assist in the validation of aeroacoustic prediction models which were developed in this program. The results were used to make an assessment of the potential benefits of different methods of source noise control. This paper summarizes the activities that took place during the research program and discusses the achievements and opportunities for noise reduction.
AIAA
Aeroacoustics; Fans; Noise Prediction; Noise Reduction; Aerodynamic Noise; Aircraft Noise

19980071167

Aeroacoustic design of a 6-bladed propeller

Lieser, J. A., DLR Inst. fuer Entwurfsaerodynamik, Germany; Lohmann, D., DLR Inst. fuer Entwurfsaerodynamik, Germany; Rohardt, C.-H., DLR Inst. fuer Entwurfsaerodynamik, Germany; Aerospace Science and Technology; Nov. 1997; ISSN 0034-1223; Volume 1,, no. 6, pp. 381-389; In English; Copyright; Avail: Aeroplus Dispatch

By reducing the diameter of a transonic propeller at constant rotational speed a significant noise reduction can be achieved. The number of blades is increased to retain the thrust. For a given design quality a loss in efficiency due to the increased propeller loading can be expected. This has to be compensated by a good design for minimum induced loss and use of optimized airfoils such as the DLR propeller airfoil family. After comparison of a blade element method, a panel method, and a Euler method, the blade element method was chosen for the aerodynamic design and the panel method was chosen for the aeroacoustic calculation. The calculations show significant changes in the acoustic signals for different tip Mach numbers and different numbers of blades. Tip shape studies based on the inviscid panel method exhibit little effect on noise but do affect efficiency.
Author (AIAA)
Propeller Blades; Aircraft Design; Noise Reduction; Transonic Speed; Propeller Efficiency

19980072805

Optimal sensor/actuator locations for active structural acoustic control

Padula, S. L., NASA Langley Research Center, USA; Palumbo, D. L., NASA Langley Research Center, USA; Kincaid, R. K., College of William and Mary, USA; 1998, pp. 1424-1434; In English
Report No.(s): AIAA Paper 98-1865; Copyright; Avail: AIAA Dispatch

Researchers at NASA/Langley have extensive experience using active structural acoustic control (ASAC) for aircraft interior noise reduction. One aspect of ASAC involves the selection of optimum locations for microphone sensors and force actuators. This paper explains the importance of sensor/actuator selection, reviews optimization techniques, and summarizes experimental and numerical results. Three combinatorial optimization problems are described. Two involve the determination of the number and position of piezoelectric actuators, and the other involves the determination of the number and location of the sensors. For each case, a solution method is suggested, and typical results are examined. The first case, a simplified problem with simulated data, is used to illustrate the method. The second and third cases are more representative of the potential of the method and use measured data. The three case studies and laboratory test results establish the usefulness of the numerical methods.
Author (AIAA)
Active Control; Noise Reduction; Aircraft Compartments

19980072891

Control of TBL pressure transmission through aeroelastic plates with LQG compensation

Frampton, Kenneth D., Duke Univ., USA; Clark, Robert L., Duke Univ., USA; 1998, pp. 2276-2282; In English

Contract(s)/Grant(s): NSF CMS-95-01470

Report No.(s): AIAA Paper 98-1980; Copyright; Avail: AIAA Dispatch

This paper presents an analytical application of Linear Quadratic Gaussian (LQG) control to reduce turbulent boundary layer (TBL) pressure transmission through an aeroelastic plate. The modeling technique for an aeroelastic plate subjected to TBL pressure disturbance which is transmitted to a stationary acoustic medium is described. A brief discussion of the LQG control system design is also provided. Results comparing the performance of LQG compensation with static output feedback control are presented. These results indicate that LQG control is more effective at reducing TBL pressure transmission.

Author (AIAA)

Elastic Plates; Aeroelasticity; Pressure Distribution; Linear Quadratic Gaussian Control; Turbulent Boundary Layer; Feedback Control

19980072892

The effect of convected fluid loading on the optimal transducer placement for active control of sound transmission through an aeroelastic plate

Smith, G. C., Duke Univ., USA; Clark, Robert L., Duke Univ., USA; Frampton, Kenneth D., Duke Univ., USA; 1998, pp. 2283-2293; In English

Contract(s)/Grant(s): NSF CMS-95-01470

Report No.(s): AIAA Paper 98-1981; Copyright; Avail: AIAA Dispatch

This paper investigates the effect of convected fluid loading on the optimal locations of colocated transducers for static output feedback control of sound transmission through an aeroelastic plate. The model of a convected fluid loaded plate coupled to a cavity is presented. The physical dimensions and parameters of the model are chosen to replicate a small commercial aircraft. Development of the appropriate cost function and optimization algorithm is discussed in detail. Case studies optimizing a control system with one colocated velocity sensor and point force actuator are presented for external flow speeds varying from Mach 0.1 to 1.1. The initial location of the sensor-actuator pair was selected arbitrarily. Results indicate that optimum transducer placement does not vary considerably over the flow speeds considered. However, in all flow cases the performance of the structural acoustic control system increased with transducer placement optimization, the greatest benefit being 6.6 dB for the Mach 0.7 case. Considerably greater reduction in the LF region was also noted after transducer placement optimization.

Author (AIAA)

Elastic Plates; Active Control; Aeroelasticity; Commercial Aircraft; Feedforward Control; Fluid Flow

19980072985

A model of a curved piezo-structure for Active Structural Acoustic Control

Henry, James K., Duke Univ., USA; Clark, Robert L., Duke Univ., USA; 1998, pp. 3223-3231; In English

Contract(s)/Grant(s): NCC1-250

Report No.(s): AIAA Paper 98-2087; Copyright; Avail: AIAA Dispatch

Current research in Active Structural Acoustic Control (ASAC) relies heavily on accurately capturing the dynamics of the structure being controlled. The application of ASAC to aircraft interior noise requires a model of the curved panels which comprise the skin of the fuselage of an aircraft. This paper presents a model of a simply-supported curved panel with attached piezoceramic sensor/actuators. The model is validated by comparison to previous work. Further, experimental results for a simply-supported curved panel test structure are shown to support the model. The effects of curvature on the structural dynamics and their relevance to ASAC are discussed.

Author (AIAA)

Active Control; Vibration Damping; Aircraft Compartments; Fuselages; Piezoelectric Transducers; Noise Reduction

17
SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

19980051613

The training cycle - An organizational perspective

Miller, Roger, Ansett Australia, Melbourne, Australia; Aviation training: Learners, instruction and organization; 1997, pp. 348-359; In English; Copyright; Avail: Aeroplus Dispatch

The organizational considerations in aviation training, and the training cycle in particular, include: training philosophies; training requirements (both regulatory and corporate); training value (measurement methods); training hardware and software; training constraints (budgets and scheduling); and testing mechanisms. Significant among the many training demands are: the operation of different generation fleets, with old and new technology; the total integration of CRM and Human Factors training; and the design of efficient, effective, and readily-measurable training programs within the multitude of training demands. In an industry fast becoming self-regulating, it is the last which is gathering increasing importance, as exemplified by the FAA Advanced Qualification Program. Change is also being driven by the need for increasing efficiencies in the modern business environment in which aviation is a particularly expensive enterprise. Modern aircraft with glass cockpits, complex computer management, and flight systems require training derived from contemporary educational design and development.

Author (AIAA)

Training Evaluation; Aeronautics; Training Analysis; Pilot Training; Airline Operations

19980051617

The management of change in aviation training

MacLeod, Norman, Royal Air Force, UK; Aviation training: Learners, instruction and organization; 1997, pp. 300-310; In English; Copyright; Avail: Aeroplus Dispatch

This chapter examines change in aviation training from a personal perspective. We look at what we mean by change and what events can give rise to it. We discuss the modes in which change can be implemented as well of some of the barriers that are encountered. The mechanics of resistance is examined, and a change management strategy is outlined.

Author (AIAA)

Pilot Training; Aeronautics

19980056025

A multi-national, multi-disciplinary, vertically integrated, team experience in aircraft design

Marchman, James F., III, Virginia Polytechnic Inst. and State Univ., Blacksburg, USA; Jan. 1998; In English

Report No.(s): AIAA Paper 98-0822; Copyright; Avail: Aeroplus Dispatch

An experiment in team capstone design education which began by adding engineering freshmen to traditional senior design groups has expanded into one involving freshmen, sophomores, juniors, and seniors in a large, multidisciplinary design team. The experiment has also broadened to include an international design experience by having American design students work with their peers at European schools. This multidisciplinary, international design approach has resulted in a valuable experience for its participants who are much better prepared for the team environment found in industry today and for today's era of multinational aerospace programs.

Author (AIAA)

Aircraft Design; Teams; Education; Students

19980057762

International obligations as regards safety in international civil aviation

Abeyratne, R. I. R., ICAO, Canada; Aeronautical Journal; Dec. 1997; ISSN 0001-9240; Volume 101,, no. 1010, pp. 457-466; In English; Copyright; Avail: Aeroplus Dispatch

The present evaluation of the work being conducted by the ICAO in aviation technical safety oversight notes that these activities are highly effective, and stand to be further improved by the ICAO's extension of its oversight program to areas beyond technical factors, such as those of human conduct both on the ground and in the air. The time is also approaching for consideration of an international regulatory regime for the activities of ATC personnel and the activities of aircraft maintenance personnel.

AIAA

Civil Aviation; International Law; Air Law; Flight Safety; Flight Crews

19980058136

Draft convention seeks to consolidate and modernize the elements of the Warsaw systems

Weber, Ludwig, ICAO, Canada; Jakob, Arie, ICAO, Canada; ICAO Journal; Oct. 1997; ISSN 0018-8778; Volume 52, no. 8, pp. 5-7; In English; Copyright; Avail: Aeroplus Dispatch

In pursuit of the definition of a new regime for air carrier liability, the ICAO Legal Committee has approved a draft convention to be acted on by a diplomatic conference. The current rules derive from the Warsaw System, encompassing the Warsaw Convention and related legal instruments (Guadalajara Convention, Hague Protocol, and Montreal Protocol No. 4) dating as far back as 1929; most states favor comprehensive modernization.

AIAA

Air Law; Legal Liability; Conventions; Air Transportation; Civil Aviation

19980058137

Contracting states urged to ratify a protocol prohibiting use of weapons against civil aircraft

Augustin, John V., ICAO, Canada; ICAO Journal; Oct. 1997; ISSN 0018-8778; Volume 52, no. 8, pp. 11-13; In English; Copyright; Avail: Aeroplus Dispatch

In order to overcome the interpretive ambiguities and actual loopholes associated with current legal protections of civil aircraft against the use of force, the 1984 Article 3 bis Protocol of Amendment to the Convention on International Civil Aviation (Chicago, 1944) must be ratified by 12 more Contracting states to become law. Article 3 was prompted by the Soviet interceptors' destruction of Korean Airlines Flight 007.

AIAA

Air Law; Civil Aviation; Passenger Aircraft; Attacking (Assaulting); International Law; Flight Safety; Weapons Delivery

19980058138

Air law instrument facilitates transfer of safety responsibilities between States

Verhaegen, Benoit M., ICAO, Canada; ICAO Journal; Oct. 1997; ISSN 0018-8778; Volume 52, no. 8, pp. 15-18, 30; In English; Copyright; Avail: Aeroplus Dispatch

Article 83 bis, an amendment to the Chicago Convention of 1944, which entered into force in 1997, enhances commercial aviation safety by allowing the transfer of certain functions and duties normally conducted by the State of registry. Transfers of this kind should allow effective airworthiness and licensing control, as well as control with compliance with the rules of the air, by the State of the operator rather than the State of aircraft registry.

AIAA

Air Law; Legal Liability; Conventions; Flight Safety

19980060255

Directing and managing cost-effective design; Proceedings of the Conference, London, UK, Jan. 27, 1998

1998; In English; ISBN 1-85768-014-6; Copyright; Avail: Aeroplus Dispatch

Various papers on the direction and management of cost-effective design are presented. The topics addressed are: driving down product introduction costs in Airbus, use of cross-functional design team practices for cost-effective design, new opportunities and stubborn problems in engineering design, achieving breakthrough performance with multidisciplinary teams, and successes and failures in directing and managing cost-effective design.

AIAA

Conferences; Cost Effectiveness; Aeronautical Engineering; Aircraft Design

19980060454

Pooling expert opinions using Dempster-Shafer theory of evidence

Mellouli, Khaled, Inst. Superior de Gestion de Tunis, Tunisia; Elouedi, Zied, Inst. Superior de Gestion de Tunis, Tunisia; 1997, pp. 1900-1905; In English; Copyright; Avail: Aeroplus Dispatch

We propose a method based on the Dempster-Shafer theory of evidence to pool expert judgments about the hypotheses of the studied field and to get an assessment and even a ranking of the different scenarios. We start by presenting scenarios and then describe an aggregation method of expertise based on probabilities and its limitations. Finally, we propose our method for pooling expert opinions using belief functions.

Author (AIAA)

Judgments; Air Transportation; Fuzzy Systems

19980063059

Some legal aspects of aviation safety ***Quelques aspects juridiques de la securite aerienne***

Vellas, Pierre, Toulouse I, Univ., France; Nouvelle Revue d'Aeronautique et d'Astronautique; Dec. 1997; ISSN 1247-5793, no. 6, pp. 25-28; In French; Copyright; Avail: Aeroplus Dispatch

The author argues that the current aviation safety regulations are not sufficient, and that current rules applications are deficient. In fact, he states that the major problem is to ensure proper rules application. Judiciary control can make an important contribution to flight safety whatever criticisms may be leveled against it.

AIAA

Flight Safety; Law (Jurisprudence); Air Law

19980063068

University education of airline pilots in the USA ***La filiere universitaire de formation des pilotes de ligne aux Etats-Unis***

Rosso, Raymond, Ecole Nationale de l'Aviation Civile, France; Revel, Pascal, Ecole Nationale de l'Aviation Civile, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Dec. 1997; ISSN 1247-5793, no. 6, pp. 61-65; In French; Copyright; Avail: Aeroplus Dispatch

The authors first describe the USA university system for educating airline pilots. This system is then compared to the ENAC (Ecole Nationale de l'Aviation Civile) syllabus. The authors then suggest the development of a new system for European universities compliant with the JAR-FCL (Joint Aviation Requirements - Flight Crew Licenses) regulation.

AIAA

University Program; Pilot Training; USA; Transport Aircraft

19980065398

Collaborative vision

Masefield, Charles, U.K. Defence Export Services Organisation, UK; Aerospace International; Feb. 1998; ISSN 0305-0831; Volume 25, no. 2, pp. 12-16; In English; Copyright; Avail: Aeroplus Dispatch

This lecture by the head of the UK Defence Export Services Organization honoring the Wright Brothers emphasizes the key role of collaboration in the European aerospace industry. Some important issues facing the industry in the near future are addressed, as are UK's translatlantic relationships and future opportunities.

AIAA

Aerospace Industry; Europe; International Cooperation; Military Aircraft; Aircraft Production

19980067147

Standards - The key to competence

Hines, Tony, Aviation Training Association, UK; 1997, pp. 1.1-1.19; In English; Copyright; Avail: Aeroplus Dispatch

The development, structure, and application of standards within the aviation industry are discussed. Standards for engineering and aircraft maintenance are examined and national vocational qualifications, key skills, and modern apprenticeships are discussed.

AIAA

Aircraft Industry; Standards; Flight Training; Aircraft Pilots; Training Evaluation

19980067148

Training - An integrated approach within the JAA

McKenna, James, Civil Aviation Authority, UK; 1997, pp. 2.1-2.10; In English; Copyright; Avail: Aeroplus Dispatch

The introduction of JAR-66, entitled Certifying Staff - Maintenance, and JAR-147, Approved Maintenance Training Organisations in 1998, represents a watershed in Europe for the training and qualification of maintenance staff. For the first time a 'harmonized' licensing requirement will be applied by the 27 JAA member States. This paper discusses the certification of mechanics, technicians, and base maintenance engineers under these new regulations.

AIAA

Systems Integration; Training Evaluation; Aircraft Maintenance; Certification; Standards; Flight Training

19980067150

Training the Army aircraft technician for the 21st century

Cameron, Stuart, Reading, Univ., UK; 1997, pp. 6.1-6.7; In English; Copyright; Avail: Aeroplus Dispatch

The Royal Electrical and Mechanical Engineers (REME) relies on two technician trade groups to support British Army aircraft: the Aircraft Technician and the Avionic Technician. Their formal training, as with the aircraft engineer, is the responsibility of the School of Electronic and Aeronautical Engineering. This paper describes the technical carrier progression within REME, the process by which career courses for the technicians have been developed, and the manner in which the delivery of training is validated to ensure that it meets the needs of the customer. It also develops the aspiration to achieve civilian qualifications, specifically NVQs, to enable the Corps to recruit and retain the high quality soldiers that it requires to meet the challenges of the 21st century.
Author (AIAA)
Military Aircraft; Training Evaluation; Aeronautical Engineering; Training Analysis; Operator Performance

19980067170
Managing the systems
Smith, Robert, British Airways Engineering, UK; 1997, pp. 14.1-14.9; In English; Copyright; Avail: Aeroplus Dispatch
I hope to provide readers with an insight into some of the problems encountered in managing the flight data recorder systems installed across an airline fleet. An outline of the installed system types on the British Airways fleets is given. Combined with an overview of ongoing regulation changes, this may help in understanding some of the complexities of managing flight data and cockpit voice recording system upgrades, and the corresponding changes to the data recovery systems used to transcribe recorders. Maintenance techniques for flight data recorder systems can be difficult to define and implement in a cost-effective manner. A well-thought out maintenance policy is required if the operator is to minimize aircraft downtime while satisfying itself that all parameters are being recorded correctly. Control of flight recorder data after any reportable incident is an area where an operator needs to ensure that adequate procedures exist in order to ensure that things happen rapidly and to known procedures. There are areas in which the design and support of FDR and CVR systems could be improved in the future, and suggestions are made at the end of the paper.
Author (AIAA)
Flight Recorders; Data Recorders; Flight Management Systems; Aircraft Accidents; Flight Control

19980067624
Europe’s engine makers weigh profits of cooperation
Butterworth-Hayes, Philip, USA; Aerospace America; Jan. 1998; ISSN 0740-722X; Volume 36, no. 1, pp. 6, 9, 10; In English; Copyright; Avail: Aeroplus Dispatch
In the aircraft engine market, decisions as to when to compete, when to collaborate, and which projects to champion for aggressive development have a strategic significance that often exceeds that in any other aerospace industry sector. A survey is presently conducted of the most important West European cooperative, and competing, propulsion ventures in both the military and civilian markets; strong resistance to further transnational integration is noted.
AIAA
Aerospace Industry; Jet Engines; Economic Factors; International Cooperation; Gas Turbine Engines

19980067626
Fighters vie for future markets
Canan, James W., USA; Aerospace America; Jan. 1998; ISSN 0740-722X; Volume 36, no. 1, pp. 26-28, 31-35; In English; Copyright; Avail: Aeroplus Dispatch
By USAF reckoning, the F-15C fighter is outperformed by the Su-35, Gripen, Rafale, and EF-2000 fighters in acceleration, maneuverability, engine thrust, rate-of-climb, avionics, firepower, radar signature, and range. A survey is presently conducted of the aircraft currently competing to take the place of the F-15 as the world’s most capable air-superiority fighter, with attention to international export prospects. The effect of improving surface-to-air and air-to-air missile designs on fighter performance requirements is discussed.
AIAA
Fighter Aircraft; Marketing; Competition; Aircraft Industry

19980067742
Cost of ownership for modernization planning
Hitt, Ellis F., Battelle Memorial Inst., USA; 1997, pp. 6.2-1 to 6.2-6; In English; Copyright; Avail: Aeroplus Dispatch
Cost of ownership analysis establishes the baseline expenditures for modernization planning for improvement of current weapon systems. Modernization planning uses performance and economic analysis (EA) techniques to make rational decisions

in selection of the best alternative to modernize the weapon system(s). This paper describes the determination of cost of ownership and its use in the modernization planning process.
Author (AIAA)
Weapon Systems; Technology Assessment; Avionics; Cost Analysis

19980067746

How to customize digital avionics but spend less

Satyen, Uma D., MITRE Corp., USA; Love, W. D., MITRE Corp., USA; 1997, pp. 6.2-29 to 6.2-35; In English; Copyright; Avail: Aeroplus Dispatch

RTCA Special Committee 182 (SC-182) and the European Organization for Civil Aviation Equipment (EUROCAE) Working Group 48 (WG-48) are jointly developing Minimum Operational Performance Standards (MOPS) for an avionics computer resource (ACR). The ACR will be a generic resource, which will be loaded with partitioned software applications at the time of the aircraft system design to perform one or more specific aircraft functions. These functions could easily be upgraded, or new functions could be added, at a later time. The aim is to provide a means of reducing the development and modification costs of avionics by improving portability and streamlining the hardware and software qualification (certification) process. Different customers could install custom suites of avionic functions without the need for total recertification. Related avionics functions could be integrated to a higher degree than ever before. Assuming that various issues can be resolved, the ACR could be a major step in economically keeping up with new technology.
Author (AIAA)
Cost Analysis; Digital Techniques; Avionics; Fault Tolerance

19980067797

Collaborative decision making between the Federal Aviation Administration and the air transport industry

Gorman, Patrick E., Kaman Sciences Corp., USA; Hofmann, James, U.S. Navy, Naval Research Lab., USA; Wambsganss, Michael; 1997, pp. 9.2-23 to 9.2-28; In English; Copyright; Avail: Aeroplus Dispatch

The RTCA Task Force on Free Flight Implementation recommended 35 near-term improvements to the current NAS, suggesting the highest-return, lowest-cost items be addressed first. The rate of return on Collaborative Decision Making (CDM) has been conservatively estimated at over 400:1. A software product called Flight Schedule Monitor (FSM) was built to display real-time airport loading using ATMS (Advanced Traffic Management System) input, generate and model outcomes of possible solutions to overloading, and encourage improved communications. Communications between the FAA and the AOCs are passed via the 'AOCnet'- a high speed digital network. The AOCnet will be used to address other RTCA recommendations. Special Use Airspace Status, traffic density, unusual weather conditions, and airline information affecting NAS operations can easily be accommodated. The value of CDM lies as much in the process and potential as to what has already been accomplished.
Author (AIAA)
Decision Making; Air Transportation

19980069534

The needs of the aeronautics markets ***Les besoins des marches aeronautiques***

Ziegler, Bernard, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Jun. 1997; ISSN 1247-5793, no. 3, pp. 7-9; In French; Copyright; Avail: Aeroplus Dispatch

The effect of reducing air fares is far from linear, with a two-fold factor difference between highly industrialized regions and developing countries in terms of increased air travel. With underdeveloped countries, the factor is potentially much higher. Increased air travel can have huge social and cultural impact reaching far beyond the airline companies, the direct clients of aerospace technology researchers. Reducing air fares means reducing operating costs while maintaining the carrier's level of performance. Aerospace research in developing greater wing efficiency is essential in reducing passenger fares per kilometer. Unfortunately, contrary to the situation in the U.S., aerospace research is not considered to be a strategic domain in Europe. The European taxpayer spends five times less than the American taxpayer for fundamental research in aeronautics. Unfortunately, sufficient financing is not available since the European sector has to work with market prices imposed by the North American competition, which can count on 100 percent government funding. After discussing this situation, this article makes a case for the aerospace industry to make it known to European governments the importance of financing aerospace research in order that Europe can maintain its current second-place slot in the civil aircraft market.
AIAA
Aeronautics; Market Research; Cost Analysis; Air Transportation; Flight Crews

19980070809

Naval Air Systems Team Mishap Investigation Support Team

Trenholm, Bruce, U.S. Naval Air System Command, USA; 1997, pp. 22-24; In English; Copyright; Avail: Aeroplus Dispatch

In support of Naval Aircraft Mishap Boards (AMBs), the Naval Air System Team provides a systematic approach to mishap investigation of Aviation Life Support System (ALSS) equipment involved in a U.S. Naval aircraft mishap. The primary goal of the ALSS mishap investigation is to determine the cause and casual factors of a serious injury or fatality subsequent to an ejection or bailout. In 1994, the Naval Air System Command began looking at a new and improved way of conducting investigations regarding approach be used. Many failures are caused by a combination of events which may have been initiated by a single-point failure. The Mishap Investigation Support Team concept provides the AMBs with an analysis of the total escape system operation based on the facts derived from the individual component investigations.

Author (AIAA)

Navy; Flight Safety; Aircraft Accident Investigation; Life Support Systems

19980071430

The costs and benefits of aerodynamic design - An industrial view

Szodruch, Joachim, Daimler-Benz Aerospace Airbus GmbH, Germany; Nouvelle Revue d’Aeronautique et d’Astronautique; Apr. 1997; ISSN 1247-5793, no. 2, pp. 88-94; In English; Copyright; Avail: Aeroplus Dispatch

Looking at the design of an aircraft, the paradoxon of sequential design describes the fact that the impact of design decisions on overall cost reduces with increasing information about the aircraft, i.e. with progress in the design process. In other words, those decisions which are made early in the design process have the highest impact on the technical and financial success of the aircraft. In order to cope with these opposite trends, the product development cycle has to be reconsidered. This article discusses the process-oriented approach by analyzing the costs of development, the role of aerodynamics, and future technology development. The future challenges in aerodynamics are formulated to a rather large part by market forces, by the airlines, and, indirectly, by the passengers. Environmental issues will also be of higher importance in the future of the aeronautical business.

AIAA

Aerodynamic Configurations; Aircraft Design; Cost Analysis

19
GENERAL

19980049699

The history of the USA Navy Flight Surgeon/Naval Aviator Program

Kelly, Fred, USA; Aviation, Space, and Environmental Medicine; Mar. 1998; ISSN 0095-6562; Volume 69, no. 3, pp. 311-316; In English; Copyright; Avail: Aeroplus Dispatch

Early in the history of aviation the need for a special kind of physician who could understand the physical and psychological problems encountered by flyers was well recognized. These physicians were called flight surgeons. In 1922, Rear Admiral W.A. Moffett, USN, the first Chief of the Bureau of Aeronautics and the ’Father of Naval Aviation’, called for a group of Navy medical officers to be trained as flight surgeons. He believed that all Navy flight surgeons should be trained as pilots ’primarily in order that they may experience the emergencies and conditions that arise in flying’. This article traces the history of the Navy flight surgeon/naval aviator. It chronicles the evolution of the Navy’s flight surgeon/naval aviator program from the World War I doctor who flew seaplanes at a Naval Air Station in Italy to the present day flight surgeon/naval aviator who flies operational and test aircraft as a research pilot.

Author (AIAA)

Flight Surgeons; Aeronautics; Physicians; Physiological Effects; Training Evaluation; Aircraft Pilots

19980068661

PICAST ’3; Proceedings of the Third Pacific International Conference on Aerospace Science & Technology, Xian, China, Sept. 1-5, 1997

1997; In English; ISBN 7-5369-2758-4; Copyright; Avail: Aeroplus Dispatch

Various papers on aerospace engineering are presented. Some individual topics addressed include: international survey of internal strain gage balances, design of the Indonesian Transonic Speed Tunnel, laser ultrasonic method for vortex measurements, concentration measurements in compressible mixing flow, grid generation techniques for complex aerodynamic configurations, transonic wing for laminar and turbulent flow, high-speed flow design using osculating axisymmetric flows, numerical study of

shock/blast wave focusing in water, control of shock-induced separation by surface suction, viscous-inviscid analysis of transonic flow about wings, numerical computation of buffet boundaries for wings, grid generation around multiple element airfoils, semi-active flutter control by structural asymmetry, exact solution of H-infinity optimal controllers with time delay, inlet ramp regulating system with angle of attack, active vibration control of a cantilever beam, and study of the behavior of solid rocket nozzles. Also considered are: new approach to multipulse rocket motor design, geometric effects in hybrid rocket fuel burning rate, experiments on air-assist spray and spray flames, effects of multistage thrust or SRM on direction dispersion, basic laws of dynamic optimization problems, knowledge-based system for the design of wing structures, optimization studies on composite wing structure, characteristics of adaptive feedforward vibration control, analysis of field maintenance technology for a helicopter, experimental study of circulation control tailbooms, application of avionics to the Lifesaving System, new type of ejection seat with canopy, computer simulation for a bombing trajectory, mechanical properties and texture of Al-Mg-Li alloy sheet, and microanalytical study of TiB2 reinforced NiAlFe composite.
AIAA
Conferences; Aerospace Engineering; Aerodynamics

19980070771

The history of the research and development of G protection in the USAF School of Aerospace Medicine (1970-1990)

Burton, Russell R., USAF, Armstrong Lab., USA; SAFE Journal; Aug. 1997; ISSN 0191-6319; Volume 27, no. 3, pp. 208-212; In English; Copyright; Avail: Aeroplus Dispatch

A development history is presented for G-suit systems for a 20-year period that witnessed the transition of USAF pilots from the 7-G maneuvering F-4 Phantom to the 9-G capable F-15. The period has demonstrated that R&D in this field is very time-consuming, and that a basic technology push is of such fundamental importance that it must not be subordinated to perceived immediate needs.
AIAA
Aerospace Medicine; Aircraft Pilots; F-4 Aircraft; F-15 Aircraft

19980071421

The forgotten astronauts of the X-15 project ***Les astronautes oublies du projet X-15***

Candal, Yves, DGA, Direction des Constructions Aeronautiques, France; Nouvelle Revue d'Aeronautique et d'Astronautique; Feb. 1997; ISSN 1247-5793, no. 1, pp. 58-68; In French; Copyright; Avail: Aeroplus Dispatch

The history behind the development of the X-15 rocket-powered airplane is reviewed, and a description of the X-15 is given. Since the X-15 pilots flew above the 50-mile altitude mark, NASA, the USAF, and the U.S. Congress felt that they deserved the title of astronauts, and thus would be the first true astronauts. The original X-15 astronauts are listed, along with their specific X-15 test flights.
AIAA
X-15 Aircraft; Astronauts; Aircraft Design

19980071526

The standoff observation of enemy ground forces from Project PEEK to JointSTARS - A prolusion

Fowler, Charles A., C.A. Fowler Associates, USA; IEEE Aerospace and Electronic Systems Magazine; Jun. 1997; ISSN 0885-8985; Volume 12, no. 6, pp. 3-17; In English; Copyright; Avail: Aeroplus Dispatch

The JointSTARS aircraft and their associated ground stations system makes use of moving target indicator (MTI) radar to provide a picture of all the moving ground vehicles and helicopters throughout most of the theater and presents the information in such a way that enemy force size, makeup, disposition, actions, and, in some cases, intentions are evident. This capability covers the range from small unit actions to major force movements. The timeliness and accuracy of the information is of targeting quality. This paper is an account of the evolution of JointSTARS, describing the U.S. Army events, the U.S. Air Force events, and the JOINT program which led up to the development and acquisition of JointSTARS.
AIAA
Warfare; Military Aircraft; Reconnaissance Aircraft; Aerial Reconnaissance; Moving Target Indicators; Defense Program

Subject Term Index

A

B

C

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Personal Author Index

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

X

Y

Z

Report Documentation Page

1. Report No. NASA/SP—1998-7037/SUPPL377	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Aeronautical Engineering A Continuing Bibliography (Supplement 377)		5. Report Date June 26, 1998 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No. 10. Work Unit No.
9. Performing Organization Name and Address NASA Scientific and Technical Information Program Office		11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Langley Research Center Hampton, VA 23681		13. Type of Report and Period Covered Special Publication 14. Sponsoring Agency Code
15. Supplementary Notes		
16. Abstract This report lists reports, articles and other documents recently announced in the NASA STI Database.		

17. Key Words (Suggested by Author(s)) Aeronautical Engineering Aeronautics Bibliographies		18. Distribution Statement Unclassified – Unlimited Subject Category – 01	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 596	22. Price A25/HC

For sale by the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320